FOURTH FIVE-YEAR REVIEW REPORT
SOLID STATE CIRCUITS, INC. SUPERFUND SITE
REPUBLIC, GREENE COUNTY, MISSOURI

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LIST OF ABBREVIATIONS

AOC	Administrative Order on Consent
Agencies	Department and EPA collectively
AR	Administrative Record
ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
bls	below land surface
bsg	below surface grade
BERA	Baseline Ecological Risk Assessment
BW	Body Weight
CalEPA	California Environmental Protection Agency
CD	Consent Decree
CD/SOW	Consent Decree/Statement of Work
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-dichloroethene
CSR	Code of State Regulations
COCs	Contaminants of Concern
COPCs	Contaminants of Potential Concern
CW	Republic/Brookline municipal well
DBR	Deep Bedrock
DHSS	Department of Health and Senior Services
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
EISB	enhanced in-situ bioremediation
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference
1,1,1-TCA	1,1,1-trichloroethane
EWI	Environmental Works, Incorporated
ft.	feet
FYR	Five-Year Review
FM/ED	Force Majeure/Excusable Delay
GMMP	Groundwater Monitoring and Management Plan
gpm	gallons per minute
HEAST	Health Effects Assessment Summary Tables
HWP	Hazardous Waste Program
HHRA	Human Health Risk Assessment
ICs	Institutional Controls
IR	Inhalation Rate
IRIS	Integrated Risk Information System
ISCO	In-Situ Chemical Oxidation
ITRC	Interstate Technology & Regulatory Council
MCLs	Maximum Contaminant Levels
µg/L	micrograms per liter
mg/kg	milligrams per kilograms
mg/m^3	milligrams per meter cubed
Department	Missouri Department of Natural Resources
MO	Missouri
MRAC	Missouri Remedial Action Corporation

LIST OF ABBREVIATIONS (Cont'd)

MSFS	Main Street Fracture System
NCP	National Contingency Plan
NCEA	National Center for Environmental Assessment
NPL	National Priorities List
NSOC	National Synthetic Organic Chemical Survey
O&F	Operational and Functional
O&M	Operation and Maintenance
PCE	Tetrachloroethylene
POTW	Publicly Owned Treatment Works
ppb	parts per billion
PPWP	Pilot Project Work Plan
RAGS	Risk Assessment Guidance for Superfund
RALs	Risk Assessment Levels
RAOs	Remedial Action Objectives
RD	Remedial Design
RDDP	Remedial Design Document Package
Registry	Missouri *Registry of Confirmed Abandoned and Uncontrolled Hazardous Waste Disposal Sites*
RfC	Reference Concentration
RfDi	Inhalation Reference Dose
RL	Reporting Limit
RP	Responsible Party
PPRTV	Provisional Peer Reviewed Toxicity Values
PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RAA	Rolling Annual Average
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SBR	Shallow Bedrock
SDWA	Safe Drinking Water Act
SOW	Statement of Work
SPHEM	Superfund Public Health Effects Manual
SSC	Solid State Circuits
SSI	Supplemental Site Investigation
trans-1,2-DCE	trans-1,2-dichloroethene
T-2-E	Treatment System Effluent
TBC	To Be Considered
TCA	Trichloroethane
TCE	Trichloroethylene
TCL	Target Compound List
TPI	POTW Influent
UFSB	Unconsolidated/Fractured Shallow Bedrock
VOC(s)	Volatile Organic Compound(s)
WQS	Water Quality Standards

EXECUTIVE SUMMARY

The remedial action for the Solid State Circuits, Inc. (SSC) Superfund site in Republic, Greene County, Missouri, includes the extraction of contaminated groundwater from the three aquifers (unconsolidated fractured shallow bedrock [UFSB], shallow bedrock [SBR] and deep bedrock [DBR]); the on-site physical/chemical treatment by a dual-tower air stripper to promote volatilization of the contaminants from the extracted groundwater; the discharge of treated effluent to the Republic Publicly Owned Treatment Works (POTW) to undergo additional off-site treatment; the enactment of a city of Republic ordinance to prevent construction of drinking water wells in or near the contaminated plumes thus preventing the direct contact/ingestion of contaminated groundwater before remediation is complete; and continued monitoring to determine the effectiveness of the remedy. The remedy did not include contaminated soils and debris, since it was assumed at the time the Record of Decision (ROD) was written that previous removal response actions had fully addressed them.

The SSC site was determined to be operational and functional on May 19, 1994. The SSC site is on the National Priorities List (NPL) and the state's Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri (*Registry*). The trigger for the fourth Five-Year Review (FYR) is the previous (third) FYR submitted on September 12, 2007. The first three FYRs found the remedy was implemented in accordance with the requirements of the 1989 ROD. Long-term trends indicate that the progress toward achievement of remedial action objectives (RAOs) is ongoing; however, recent progress has slowed and it is unlikely that the remedy will be completed within the estimated timeframe of 40 years at the current pace.

Based on the data and information presented in the fourth FYR, the protectiveness determination of the remedy is deferred since a) the footprint of the contaminant plume in all three water bearing zones is not fully delineated; b) the migration of the contaminant plumes is not under control due to the destruction of the treatment system by fire in December 2011; c) soil source contamination has been discovered on site that may continue to contribute to groundwater contamination; d) it is unclear if the Institutional Controls (ICs) fully address the entire contaminant plume footprints, or if different ICs would be more appropriate; and e) to date, it does not appear that sufficient data exists to state that vapor intrusion (VI) is not an issue for all structures over the contaminant plumes.

Further data and information will be obtained by taking the following actions: completing a comprehensive vapor intrusion study of all structures overlying potentially impacted groundwater, addressing all soil source areas, delineating the contaminant plumes in all three water bearing zones and fully containing the contaminant plumes in groundwater. It is expected that these actions will take approximately 3.5 years to complete, at which time a protectiveness determination will be made.

The next FYR for the SSC site is due in September 2017, five years from the signature date of this review.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Solid State Circuits, Inc.		
EPA ID: MOD980854111		
Region: 7	**State:** MO	**City/County:** Republic/Greene

SITE STATUS	
NPL Status: Final	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: State **If "Other Federal Agency" was selected above, enter Agency name:** Missouri Department of Natural Resources/Hazardous Waste Program
Author name (Federal or State Project Manager): Candice McGhee
Author affiliation: State of Missouri
Review period: 07/15/2011 – 06/30/2012
Date of site inspection: 03/06/2012
Type of review: Statutory
Review number: 4
Triggering action date: Previous Five-Year Review Completion Date
Due date *(five years after triggering action date)*: September 12, 2012

Five-Year Review Summary Form (cont'd)

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Issues and Recommendations Identified in the Five-Year Review:

OU(s): Sitewide/OU1	**Issue Category: Remedy Performance**			
	Issue: Re-evaluate progress towards achieving RAOs			
	Recommendation: Re-evaluate the progress towards achieving RAOs after cleanup/removal of soil source areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State/EPA	04/01/2015

OU(s): Site-wide/OU1	**Issue Category: Changed Site Conditions**			
	Issue: Delineate horizontal and vertical limits of UFSB and SBR plumes			
	Recommendation: Install additional monitoring wells in the UFSB and SBR to confirm horizontal and vertical plume boundaries.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
*	Yes	PRP	State/EPA	04/01/2015

OU(s): Sitewide/OU1	**Issue Category: Monitoring**			
	Issue: Define vapor intrusion (VI) plume			
	Recommendation: Conduct quantitative vapor intrusion (VI) study to confirm and remediate the VI pathway.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
*	Yes	PRP	State/EPA	04/01/2015

*** - The effect of these issues on current protectiveness is not known at this time.**

Five-Year Review Summary Form (cont'd)

OU(s): Sitewide/OU1	**Issue Category: Changed Site Conditions**			
	Issue: Remediate/remove soil source areas			
	Recommendation: Treat/remove the three VOC contaminated soil source areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State/EPA	04/01/2015

OU(s): Sitewide/OU1	**Issue Category: Operations and Maintenance**			
	Issue: Complete Abandonment and Closure of Republic's CW-1 well			
	Recommendation: Complete the abandonment and closure of the CW-1 well to remove vertical VOC pathway to DBR.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State/EPA	06/30/2012

OU(s): Sitewide/OU1	**Issue Category: Institutional Controls**			
	Issue: Implement additional institutional controls (ICs)			
	Recommendation: Implement additional ICs by recording an environmental covenant with the SSC property's chain-of-title			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State/EPA	06/30/2015

OU(s): Sitewide/OU1	**Issue Category: Changed Site Conditions**			
	Issue: Assure compliance with and implementation of work required by the Force Majeure/Excusable Delay (FM/ED) Agreement			
	Recommendation: Investigate and remediate/remove the soil source areas and continue to extract and monitor the three VOC contaminant plumes in groundwater. Complete a focused feasibility study.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State/EPA	12/31/2014

Five-Year Review Summary Form (cont'd)

OU(s): Sitewide/OU1	**Issue Category: Monitoring**			
	Issue: Sample for 1,4-Dioxane (dioxane)			
	Recommendation: Add sampling for 1,4 dioxane to future groundwater sampling events to determine if this contaminant is present at the site.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
*	Yes	PRP	State/EPA	06/30/2013

*** - The effect of these issues on current protectiveness is not known at this time.**

Protectiveness Statement(s)		
Operable Unit: OU1	*Protectiveness Determination:* Protectiveness Deferred	*Addendum Due Date (if applicable):* 12/31/2015

Protectiveness Statement:
A protectiveness determination of the remedy cannot be made at this time until further data and information is obtained, due primarily to the destruction of the extracted groundwater treatment system by fire in December 2011. Further data and information will be obtained by taking the following actions: completing a comprehensive vapor intrusion study of all structures overlying potentially impacted groundwater; addressing all soil source areas; delineating the contaminant plumes in all three water bearing zones; and fully containing the contaminant plumes in groundwater. It is expected that these actions will take approximately 3.5 years to complete, at which time a protectiveness determination will be made.

Five-Year Review Summary Form (cont'd)

Sitewide Protectiveness Statement (if applicable)	
Protectiveness Determination: Protectiveness Deferred	*Addendum Due Date (if applicable):* 12/31/2015
Protectiveness Statement: A protectiveness determination of the remedy cannot be made at this time until further data and information is obtained, due primarily to the destruction of the extracted groundwater treatment system by fire in December 2011. Further data and information will be obtained by taking the following actions: completing a comprehensive vapor intrusion study of all structures overlying potentially impacted groundwater; addressing all soil source areas; delineating the contaminant plumes in all three water bearing zones; and fully containing the contaminant plumes in groundwater. It is expected that these actions will take approximately 3.5 years to complete, at which time a protectiveness determination will be made.	

Solid State Circuits, Inc.
Republic, Missouri
Fourth Five-Year Review Report

I. INTRODUCTION

The purpose of a five-year review (FYR) is to determine whether the remedy at a site is protective of human health and the environment. The FYR report documents the methods, findings, and conclusions of a review. In addition, the FYR report identifies issues found during the review and makes recommendations to address them.

The Missouri Department of Natural Resources/Hazardous Waste Program (Department/HWP), the lead agency, is preparing the fourth FYR report with assistance by the U.S. Environmental Protection Agency (EPA) for this National Priorities List (NPL) Site, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Oil and Hazardous Substance Pollution Contingency Plan (National Contingency Plan or NCP, 40 CFR Part 300). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The NCP, 40 CFR §300.430(f)(4)(ii), states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The Department, assisted by the EPA, conducted the Fourth FYR (FYR) for the Solid State Circuits, Inc. site (Site) in Republic, Greene County, Missouri. The Department and EPA project managers conducted this review for the entire Site from July 15, 2011 through September 2012. This report documents the results of the review.

This is the fourth FYR for the Site. The approval of the third FYR is the triggering action for this statutory review, which was signed on September 12, 2007. The FYR is required since hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. The Department is submitting the fourth FYR report for the Site to the EPA for its concurrence pursuant to 40 CFR §300.515.

II. Site Chronology

Table 1 - Site Chronology

Key Event	Date
SSC manufactured printed circuit boards	1968 to 11/1973
TCE discovered in CW-1 during NSOC Survey	06/1982
Agencies conducted response activities	04/1983 to 03/1984
SSC site placed on the MO *Registry*	02/22/1985
Department and PRPs conducted Removal Activities	03/1985 to 11/1985
EPA signed Action Memorandum	4/5/1985
EPA conducted Removal Activities	4/5/1985 to 10/31/1985
Multi-Site Cooperative Agreement between Agencies signed	10/01/1985
Final listing on EPA National Priorities Listing (NPL)	06/10/1986
Settlement Agreement & Consent Decree entered by Federal Court	11/20/1986
Stipulation & Joint Motion to Amend Settlement Agreement & Consent Decree entered by Federal Court	02/04/1988
SSC conducted Remedial Investigation/Feasibility Study (RI/FS)	12/1986 to 07/1989
ROD selecting the remedy was signed & executed	09/27/1989
Administrative Order for Remedial Design & Remedial Action (RD/RA) was entered by Federal Court	06/20/1990
Consent Decree/Statement of Work (CD/SOW) was signed	07/25/1990 to 11/23/1990
RD Pilot Remediation Program	09/01/1991 to 1/31/1992
100% RD Document Package (100% RDDP) was submitted	10/1992
100% RDDP approved by Department with EPA concurrence	12/22/1992
Implementation of Remedial Action (RA) Construction	01/11/1993
RA Construction completion date	09/20/1993
Preliminary Close Out Report received by the Department	12/01/1993
RA Certification Report received by the Department	05/1994
RA Operation & Maintenance (O&M) Plan approved	06/16/1994
ESD modifying UFSB and DBR chemical quality and hydraulic performance monitoring standards	10/24/1996
First FYR approved	12/12/1996
Horizontal well pilot test	2001-2002
Second FYR approved	09/20/2002
ESD to allow full operation of the horizontal well	09/2004
Gore-Sorber Soil Vapor Survey Report approved	08/28/2007
Third FYR approved	09/12/2007
Supplemental Site Investigation for soil and groundwater	11/2009 - 03/2010
Draft Pilot Program Work Plan for Soil Source Area 1 submitted	01/07/2011
Public Notice for Start of Fourth FYR Process	07/15/2011
Supplemental Site Investigation (SSI) Report approved	07/28/2011
Partial (DBR) abandonment of Republic's CW-1 well	11/08/2011
Groundwater Pump and Treat Facility fire and limited site visit	12/08/2011
Fourth FYR site visit	03/06/2012

III. Background

A. Physical Characteristics

Site Location

The Solid State Circuits, Inc. (SSC) site is located in T29N, R23W Section 20 or 37° 07' 00" N, 93° 28' 48" W. The Site is located on the southeast corner of the intersection of Main and Elm Streets in Republic, Missouri (Figure 1). Republic is approximately 12 miles southwest of Springfield in Greene County, Missouri. The current population of Republic (2010) is approximately 14,750 residents. The Site includes the northern end of the former plant building, the soils below and around the former building and portions of the on-site and off-site underlying groundwater aquifers. The Site is less than one acre in size and is enclosed within a six-foot high chain link fence (Figure 2).

Site History

The original plant building and basement, which extended the entire length of Main Street between Mill and Elm Streets, was constructed prior to 1902 and was originally operated by a milling company. The northern portion of the building was four stories tall, while the remaining portion was one story. The former plant building has a relatively unclear history and very little is known about chemicals used on-site, although it had been leased or owned by numerous businesses through the years. From approximately 1902 to 1937 a cold refrigeration plant operated in the northern portion of the building.

SSC operated in the northern portion of the building from 1968 until November 1973, when SSC moved. During that time, SSC manufactured printed circuit boards and used trichloroethylene (TCE) in the manufacturing process. The extent and amount of TCE used is unclear due to poor record keeping.

Micrographics, Incorporated, a photographic-processing firm, operated on-site from 1973 until 1979. In November 1979, the northern end of the building was damaged by fire. The damaged portion was demolished and the debris was pushed into the basement. The basement area was then filled to grade and became a vacant gravel lot. The remaining vacant portion of the building was repaired and refurbished; however, it is beginning to show signs of neglect again.

The Crane Manufacturing Company of Crane, Missouri, owned the property until 1976. Mr. Nicholas Weinsaft purchased the property and owned it from 1976 until 1998. Mr. Lance McKnelley and Mr. James Don Rogers purchased the property in 1998. Mr. McKnelley sold his portion to Mr. Rogers in 1999. Currently, Mr. James Don Rogers is the property owner.

Geological and Hydrogeological Characteristics

The Site lies on a broad upland setting with regional karst development within the Springfield-Salem Plateau section of the Ozark Plateau physiographic province of the Interior Highlands major division. The City of Republic is located on a northeast-southwest trending topographic

high that serves as a drainage divide between the Sac River (north) and the Shuyler Creek/Wilson Creek/James River (south). Elevation at the Site is approximately 1,300 feet above mean sea level.

Surface soils in the vicinity of the Site are classified as Creldon silt loam, which are deep, moderately well drained and formed on the tops and sides of ridges and upland areas. Soils beneath the Site consist of a sandy clay containing fragments of weathered limestone or fill material. Off-site soils are silty clay loam that contains sand and weathered limestone fragments, are generally 15 to 25 feet thick, consist of residuum weathered from the underlying bedrock and contain increasing amounts of sand and gravel near the bedrock contact.

Bedrock beneath the Site consists of, in descending order, Mississippian, Ordovician, Cambrian and Pre-Cambrian formations. The Mississippian Formations are generally coarse crystalline limestone with discontinuous beds of chert, ranging from 80 feet to 230 feet thick. Below these limestone formations lies the Mississippian Northview Shale, a shale and limestone unit, which ranges in thickness from 5 to 30 feet across the region. Below the Northview Shale lies an additional Mississippian formation, a very thick sequence of Ordovician and Cambrian formations and the Pre-Cambrian basement bedrock complex. A cross section of the subsurface geology is shown on Figure 9.

Periodic uplifting of the Ozark Plateau region has resulted in extensive faulting, fracturing and the development of joints in the bedrock. Locally, numerous structural features, including lineations, have been identified in the Republic area. The Remedial Investigation (RI) identified a fracture zone (the Main Street Fracture System [MSFS]) in the upper portion of the shallow bedrock that trends southward from the Site along Main Street to Republic's former municipal well CW-1. South of CW-1, the MSFS trends towards the southeast and extraction well SSC-31.

Dissolution of the limestone and dolomite can result in the development of karst topography, which includes springs, losing streams, sinkholes and caves. Karst topography also affects the surface water hydrology such as Shuyler Creek, which is classified by the Department as a losing stream. Stream flow in Shuyler Creek is lost to the shallow bedrock aquifer and is thought to feed Roberts Spring (Figure 1).

There exists a sequence of three hydrologic groundwater aquifers that underlie the Site. The aquifers are Unconsolidated/Fractured Shallow Bedrock (UFSB) aquifer, the Shallow Unfractured Bedrock (SBR) aquifer and the Deep Bedrock (DBR) aquifer.

The UFSB aquifer is the upper-most aquifer. It includes the saturated portion of the unconsolidated residuum and the fractured/weathered portion of the upper shallow bedrock unit. The UFSB extends to approximately 70 feet below ground surface (bgs). The upper 15 to 25 feet of off-site soils consists of residuum weathered from the underlying bedrock. The underlying bedrock is limestone that has solution weathering along joints and bedding planes, which are avenues of rapid fluid transport to groundwater. The regional groundwater flow in the UFSB is generally to the south-southeast towards Shuyler Creek and Roberts Spring.

The SBR aquifer includes the lower unfractured shallow limestone bedrock from approximately 70 feet bgs to approximately 300 feet bgs, which is the top of the Northview Shale. The lower portion of the SBR to about 300 feet bgs can locally produce about 100 gallons per minute (gpm). Regional groundwater flow in the SBR is generally to the southeast with possible local influence from the Republic municipal well field.

The DBR aquifer includes the deep limestone/dolomite/sandstone bedrock below the Northview Shale to approximately 1,300 feet bgs. Under static, non-pumping conditions, the regional groundwater flow direction is to the southeast. However, due to the strong influence from the Springfield municipal well field, the regional groundwater flow direction is generally to the northeast towards Springfield. Republic's municipal wells are located to the west and northeast of the Site. The wells were installed into the Ozark aquifer and influence the direction of groundwater flow within the DBR on a local scale when pumping.

On a local scale, groundwater flow in the UFSB and SBR is towards Shuyler Creek and Roberts Spring. The groundwater flow in the UFSB near the Site is thought to be generally towards the MSFS. Studies performed during the RI indicate that there is hydraulic communication between the UFSB and the SBR. Groundwater level measurements indicate that there is a downward hydraulic gradient between these aquifer units. A vertical hydraulic gradient exists across the Northview/Compton Formations, which are considered to act collectively as a leaky confining unit to the underlying Ozark aquifer. Due to considerable pumping of the DBR aquifer for municipal and industrial use, an increase in leakage across these units into the DBR may occur.

B. Land and Resource Use and Re-Use

The Site lies within the downtown area of Republic and the surrounding land use is urban. Residential areas exist to the east and two blocks to the west and south. Most of the dwellings are single family homes, although a six family complex is located across Main Street from the former CW-1 well and a duplex is two-blocks south of CW-1. Commercial properties, including light industry and warehouses, are intermingled with the single family dwellings to the west. Light industry and City property are located to the north and south of the Site. A daycare facility was located to the north of the Site across Elm Street until early 2012.

In December 1992, the Agencies approved the groundwater cleanup alternative for the Site, which initiated the long-term operation and maintenance (O&M). The long-term O&M activities include extraction and treatment of contaminated groundwater, along with chemical quality and hydraulic performance monitoring and continued collection of water samples from on-site and off-site monitoring and extraction wells, Roberts Spring, the Republic/Brookline municipal wells and the distribution system and Republic's POTW (Figure 1). Republic's former CW-1 municipal well was the only municipal well with detections of TCE contamination. It was taken out of service in July 1983 and was partially (DBR portion only) closed in November 2011. Republic's municipal well CW-2 was taken out of service in the fall of 1997 for issues unrelated to the Site. In July 2007, municipal well CW-6 went online in the consolidation of Republic and Brookline, so currently, municipal wells CW-3, CW-4, CW-5 and CW-6 are operational and supply the Republic/Brookline water needs (Figure 1). The only aquifer that supplies water to the four functioning Republic/Brookline municipal wells is the DBR.

Prior to the December 8, 2011 on-site fire, there was no planned reuse for the Site due to the functioning of the on-site remedial action (RA) pump and treat system. The December 8, 2011 fire totally destroyed the on-site facility that housed the groundwater pump and treat system. Once the current on-site soil response actions are complete, plans may be developed for re-use of the Site as long as such plans do not interfere with any necessary O&M activities.

C. History of Contamination

Solid State Circuits manufactured printed circuit boards at the Site from 1968 through 1973 in the building's north end. Volatile organic compounds (VOCs) and metals were used in the manufacturing and plating process. Solvents, such as TCE, were used in the cleaning process. Due to a lack of viable records, a reliable estimate of the volume of hazardous substances used or released is not available.

TCE was reportedly stored in the north end basement sump pit near the basement well. Early sampling data indicated that the improper management of spent TCE and copper-plating solutions caused the on-site and off-site contamination of surface and subsurface soils, air, utility conduits, and groundwater. The elevated VOC concentrations in the on-site subsurface soils and groundwater beneath the Site indicated that an on-site release had occurred. The off-site groundwater contamination reached Republic's municipal water supply well CW-1, although the date this well was first affected is not known.

D. Initial Response

Regulatory Agency Involvement

The Department collected water samples from Republic's three municipal wells and the distribution system in June 1982 as part of the EPA National Synthetic Organic Chemical (NSOC) survey. TCE contamination was detected in Republic's municipal well CW-1, which triggered further investigations. Between April 1983 and March 1984, the Department and the EPA initiated response actions to identify contaminant sources and to further investigate the TCE occurrence in Republic's CW-1 well. The former SSC manufacturing and plating plant was identified as the source of the TCE contamination.

On August 26, 1983, the Department notified the property owner that the Site was proposed for inclusion on the Missouri *Registry of Confirmed Abandoned and Uncontrolled Hazardous Waste Disposal Sites* (Registry). The listing was appealed and an agreement was reached. The Site was placed on the Registry on February 22, 1985.

The Site was proposed for listing on the National Priorities List (NPL) on October 15, 1984. On October 1, 1985, a Multi-Site Cooperative Agreement was signed by the Department and the EPA. On October 7, 1985, the potentially responsible party (PRP or Missouri Remedial Action Corporation [MRAC]) assumed the long-term O & M responsibility of the site with the Department as the lead oversight agency. The site was listed on the NPL on June 10, 1986.

Removal History

The Department and the PRP conducted response activities at the site in four phases from March to November 1984. Extensive soil and groundwater sampling was done to delineate the on-site and off-site contamination. Part of the off-site groundwater sampling included Roberts Spring, Cave Well and Republic's municipal wells CW-1, CW-2 and CW-3. TCE contamination was only detected in CW-1. Based on the on-site soil and groundwater sampling, a basement well was discovered at the SSC facility. Contaminated on-site soils and debris were excavated from and around the basement of the former plant building. Due to Resource Conservation and Recovery Act (RCRA) disposal requirements a portion of the excavated materials were stored on-site until a proper disposal facility was located. The remaining materials were shipped to an off-site disposal facility. Three shallow monitoring wells were installed and a wooden fence was installed for site security.

On April 5, 1985, the EPA signed an Action Memorandum to undertake an immediate removal action. The removal action was conducted from April to November 1985. To determine the necessary extent of the removal, additional soil and groundwater sampling was performed. Sample results indicated that sub-basement soils and debris were highly contaminated. Most of the contaminated material was excavated to bedrock and shipped off-site for disposal along with the previously stockpiled contaminated materials; however, a portion of the basement foundation near the elevator shaft is believed to have been left in place. The basement well was abandoned per Missouri state regulations and the excavation was filled to grade with clean materials. Four additional off-site monitoring wells and two on-site extraction wells were installed. A chain-link fence with barbed wire and a locking gate were installed for added site security. Final grading and seeding were completed on October 31, 1985.

Remedial History

In December 1985, the PRP submitted a plan to the Department to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The RI/FS was conducted from December 1985 to July 1989. During this time multi-media monitoring and sampling events were conducted that included on-site and off-site air, surface and sub-surface soils, utility corridors, surface water and groundwater. Additional work included the installation of monitoring wells and the construction of a new Republic municipal well CW-4. The two air strippers were constructed and a pilot study was implemented to evaluate the extraction and treatment of the TCE and other VOC contaminated groundwater.

The RI identified TCE and other VOC contamination in the three hydrogeologic aquifers both on-site and off-site. The RI was completed and approved in June 1989, and the FS was completed and approved in July 1989. The RI/FS and the Proposed Plan were released to the public on August 14, 1989. Since the previous response actions were thought to have fully addressed the contaminated on-site soils and debris, the Record of Decision (ROD) only addressed the contaminated groundwater. The selected remedy included extraction and treatment of the contaminated groundwater, and discharge to the city of Republic's Publicly Owned Treatment Works (POTW) facility. The ROD was approved and signed on September 27, 1989.

Between December 1989 and July 1990, the Department with the EPA concurrence (Agencies) and the PRP negotiated the terms for the Consent Decree/Statement of Work (CD/SOW) for the Remedial Design/Remedial Action (RD/RA) in accordance with the ROD. Near the end of negotiations, the responsible party sold the Site's assets and the money was placed in a trust to finance the remedial action work. The effective date for the CD/SOW was May 1991. The Trust agreement was approved in October 1991.

E. Basis for Taking Action

Sample data collected during pre-remedial and remedial investigations and removal activities up to and including the RI/FS identified over 33 contaminants of potential concern (COPCs) on-site and/or off-site. Contamination, predominantly TCE, was detected in various media including on-site and off-site soils, groundwater in the three hydrogeologic aquifers, utility corridors and manholes, and the influent wastewater to the POTW. A summary of detected COPCs and their locations are found in Table 2.

Due to the large number of COPCs and the wide variations in occurrence, concentrations, and toxicities found between the COPCs, a selection process was implemented to identify contaminants of concern (COCs) for evaluation in the risk assessments (Table 3). The detection of contaminant concentrations above health-based standards was the basis for choosing the COCs for the Site. Metals were not considered COCs since their contaminant concentrations were detected below health-based standards. The COCs include 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), methylene chloride, 1,1,1-trichloroethane (1,1,1-TCA), TCE, and vinyl chloride.

The COCs chosen were used in the Human Health and Ecological Risk Assessments. The carcinogens used were 1,1-DCA, methylene chloride, TCE, and vinyl chloride. The noncarcinogens used were 1,1-DCE, trans-1,2-DCE and 1,1,1-TCA.

At the time of the Risk Assessments, federal and state standards and criteria existed to protect drinking water and fresh-water aquatic life. The federal standards (Maximum Contaminant Levels [MCLs]) and/or Missouri Water Quality Standards (MWQS) existed for the 1,1-DCE, methylene chloride, 1,1,1-TCA, TCE, and vinyl chloride. Maximum Contaminant Level Goals (MCLGs) existed for trans-1,2-DCE. No regulatory standards existed for 1,1-DCA.

Based on the Human Health Risk Assessment (HHRA), no unacceptable health risks were identified for current receptors on and around the Site; however, there was the potential for future unacceptable risks. Future risks could be a result of dermal contact with or ingestion of contaminated groundwater beneath or in close proximity to the site. To prevent future risk the following assumptions were made: that the contaminated groundwater at or near the Site will not be used for human consumption; that private and public wells will not be drilled through or near the contaminant plumes (City Ordinance); and the remediation of the contaminated groundwater would continue as required.

Table 2 - Detected COPCs by Location

COPC	On-site Ground-water	Off-site Ground-water	Republic's Drinking Water	On-site Soil	Off-site Soil	Sewer	SW Bell Telephone
Cadmium	X						
Chromium	X						
Copper			X				
Iron	X						
Lead		X					
Magnesium		X					
Manganese		X					
Mercury	X						
Nickel	X						
Zinc	X						
Acetone	X						
Benzene	X			X			
2-Butanone (MEK)		X					
Carbon Disulfide		X					
Carbon Tetrachloride	X						
Chlorobenzene	X						
Chloroethane	X						
Chloroform	X				X	X	
1,1-Dichloroethane	X			X		X	X
1,1-Dichloroethene	X			X			
1,2-Dichloroethane		X					
1,2-Dichloroethene	X						
1,2-Dichloropropane		X					
1,3-Dichloropropylene	X						X
Ethylbenzene	X				X	X	
Methylene Chloride	X	X		X			X
Tetrachloroethene	X			X			
Toluene	X				X	X	
Trans-1,2-	X			X		X	
1,1,1-Trichloroethane	X			X		X	
1,1,2-Trichloroethane	X			X			
Trichloroethene (TCE)	X	X	X	X	X	X	X
Vinyl Chloride	X			X			

Table 3 – COCs in Groundwater and Compliance Levels

COCs	Compliance Levels
1,1-dichloroethane (1,1-DCA)	None
1,1-dichloroethene (1,1-DCE)	7 µg/l
methylene chloride	5 µg/l
trans-1,2-dichloroethene (trans-1,2-DCE)	100 µg/l
1,1,1-trichloroethane (1,1,1-TCA)	200 µg/l
trichloroethene (TCE)	5 µg/l
vinyl chloride	2 µg/l

Based on the results of the Baseline Ecological Risk Assessment (BERA), no adverse effects were identified for terrestrial or aquatic ecosystems. There was no indication of threatened or endangered wildlife species; however, it was determined that should Roberts Spring become contaminated by site-related contamination in the future that it would pose a new ecological risk.

IV. Remedial Action

A. Remedy Selection

As previously discussed, the ROD for the Site was signed on September 27, 1989. Based on the data collected up to and during the RI and the evaluation of health risks, remedial action objectives (RAOs) were developed for the Site to aid in the development and screening of the remedial action alternatives. It was assumed that the previous response actions had completely addressed the contaminated on-site soils, so the following RAOs were identified during the remedy selection process only for the three contaminated groundwater aquifers. They include:

- Prevent potential exposure to contaminated groundwater;
- Protect uncontaminated groundwater for future use by preventing further migration of the contaminated groundwater plumes; and
- Restore contaminated groundwater for future use by reducing the contaminant concentrations to regulated or health-based levels.

The following additional RAO was identified and added:

- The Agencies agreed to incorporate a local ordinance to prohibit the construction of new water supply wells in or near the contaminant plumes until the remediation is complete. This will prevent direct contact and/or ingestion of contamination in groundwater.

Based upon consideration of the requirements of CERCLA, the detailed analysis of the remedial action alternatives, and public comments, the Department and the EPA determined that the remedial action alternative II, the "Pump and treatment using air strippers with treated water discharged to the Publicly Owned Treatment Works (POTW)" was the most appropriate remedy for the Site in Republic, Missouri.

Since previous response actions were thought to have fully addressed contaminated on-site soils and debris, the major components of the selected remedy in the ROD were:

1. Extraction of contaminated groundwater from the three aquifers;
2. On-site physical/chemical treatment using air stripping to promote volatilization of the contaminants from the extracted groundwater;
3. Discharge of treated effluent to the Republic POTW to undergo additional off-site treatment;
4. Enactment of an ordinance by the city of Republic to prevent construction of drinking water wells in or near the contaminated plumes to prevent direct contact/ingestion of contaminated groundwater before remediation is complete.

As part of the concurrence process, the following component was added:

5. Continued monitoring to determine the effectiveness of the remedy.

B. Remedy Implementation

The EPA issued a Remedial Design/Remedial Action (RD/RA) Special Notice Letter on December 13, 1989. Following extensive negotiations between the PRP (MRAC) and the Agencies, the Consent Decree/Statement of Work (CD/SOW) was signed by the MRAC and the Agencies. The CD/SOW was lodged with the court on January 6, 1991 and then entered by the court on May 31, 1991, thus initiating the start of RD.

The CD/SOW specifies the activities that are required to assure effective implementation of the RA. The primary activities of the RA include the installation of recovery wells into the UFSB zone, installation of an additional monitoring well in the DBR, operation of the extraction, treatment and discharge systems, on-going chemical and hydraulic monitoring, and RA reporting. It also stated that the extraction well system would consist of proposed UFSB wells (SSC-29, SSC-30 and SSC-31); existing SBR wells (SSC-6C and REM-2); and existing DBR wells (CW-1 and REM-1).

As stated in the CD/SOW, groundwater monitoring was to be conducted during RA and would include chemical and hydraulic monitoring of specific wells (monitoring, extraction, and municipal) and sampling locations. Sampling schedules for each type of monitoring were presented in detail in specific sections within the CD/SOW and discussed in depth in supporting documents submitted during RD.

The chemical monitoring of the extraction and monitoring wells and locations initially included all VOCs from the Target Compound List Analytes (TCL) and TCE. As outlined in the CD/SOW, the sampling schedule was established, and TCE and the TCL VOCs were collected and analyzed. Removal efficiencies of TCE and the TCL VOCs were compared and it was determined that the TCE removal efficiency was comparable with the TCL VOCs. This determination was the basis for using TCE as the primary indicator chemical for all chemical monitoring and reporting.

As part of the RD/RA process, a second pilot study was initiated to test various extraction well pumping schemes in order to better define the pumping and discharge rates. The results of the Pilot Study were incorporated into the 100% Remedial Design Document Package (RDDP) that was submitted to the Agencies in October 1992. The Agencies determined that the proposed system for removing TCE from the extracted contaminated groundwater was 98% to 99% efficient. On December 22, 1992, the Department approved, and the EPA concurred with, the 100% RDDP for the groundwater cleanup alternative.

RA construction began on January 11, 1993. Construction activities included the installation, testing and sampling of extraction and monitoring wells and the groundwater pump and treat system. As demonstrated, the RA consisted of groundwater extracted from the on-site and off-site UFSB extraction wells, the on-site SBR extraction wells and the on-site and off-site DBR

extraction wells to remove the VOC contamination from the three aquifers of concern, to control the movement of the contaminated groundwater away from the Site and to prevent the movement of the contaminated groundwater into the Republic municipal wells. The Site's monitoring network consisted of on-site and off-site UFSB wells, off-site SBR wells, on-site and off-site DBR wells, Republic's active municipal wells, Roberts Spring, Cave Well, Republic's POTW, two Sewer Discharge locations, and the on-site Groundwater Pump and Treat Facility (Figure 3). Republic's municipal well CW-2 was taken off-line during this time for reasons unrelated to the Site, and Republic's new municipal well CW-5 was constructed and brought online. The RA construction activities were completed on September 20, 1993.

On October 29, 1993, the Department sent the EPA the Preliminary Closeout Report for the Long-Term Operation and Maintenance at the Site. The EPA signed the document on December 1, 1993. In March 1994, the Department conducted a pre-certification inspection of the RA at the Site per the CD/SOW. The inspection determined that the RA construction was complete and that the remedy was operational and functional (O&F), since hydraulic control of the three hydrogeologic aquifers had been achieved and maintained. The EPA concurred with the O&F determination on May 19, 1994.

On May 31, 1994, the Department received the RA Certification Report and As-Built Drawings for the Site. The Agencies sent the MRAC the Department "Certification of Completion of the Remedial Action" for the Site in September 1994. The document notified the MRAC that the remedy for the Site was O&F, and it initiated the Site's long-term O&M.

C. System Operations/Operation and Maintenance

The responsible party (MRAC) is conducting, with Agency oversight, the long-term O&M of the Site according to the RA O&M Plan that was jointly approved by the Agencies on June 16, 1994. The O&M Plan specifies the procedures and monitoring to be followed as part of the day to day operations during the RA. The O&M Plan also specifies monitoring frequencies and locations, maintenance and replacement schedules, record keeping, and reporting requirements required to implement maintenance procedures and to assure continued effective remediation at the Site. Following the O&M Plan assures the long term effectiveness of each design element and provide corrective action measures should they become necessary. The basic considerations, which the O&M Plan addresses include:

- System description;
- Normal operation, inspection, and maintenance procedures and schedules;
- Potential and actual operating problems and operation troubleshooting;
- Equipment monitoring and inspection requirements;
- Monitoring requirements to ensure appropriate operation and maintenance of the recovery and treatment systems;
- Contingent corrective actions provisions when needed; and
- Record keeping and reporting requirements to include personnel and safety.

On September 23, 1994, the Department received the final copy of the "Addendum Report to the RA Groundwater Monitoring and Management Plan (GMMP)." The GMMP contains the

specific tasks required to evaluate the monitoring activities and site management as part of the groundwater RAs. The GMMP includes the requirements of the hydraulic control measures for the three hydrogeologic aquifers (UFSB, SBR, and DBR), the management of the extraction and monitoring wells (Figure 4), data collection and analysis, management practices, data reporting, and Quality Assurance/Quality Control (QA/QC) requirements.

Over time the Site's monitoring network has changed. In 2010, the municipal well system expanded to become the Republic/Brookline municipal well system due to the 2010 merger of Republic and Brookline. Currently the municipal well system includes CW-6 along with CW-3, CW-4 and CW-5. On December 8, 2011, the on-site groundwater pump and treat facility was totally destroyed by fire, thus eliminating two sampling locations associated with the groundwater pump and treat operation.

The requirements for the Site's groundwater RA are in accordance with the CD/SOW. The CD/SOW defines the schedule for the submittal of the progress reports, which are submitted by MRAC for Agency approval. This schedule was initiated following the approval of the 100% RDDP. The quarterly, annual, and FYR reports document the scheduled monthly, quarterly, and annual chemical quality and performance monitoring, along with the condition of the RA system, identifies problems and their resolutions, and all maintenance and repairs that are performed. Along with the reports, the Department collects split groundwater samples and the Agencies conduct site visits to verify the status of the site's long-term O&M.

The O&M costs for the fourth FYR include all of the aforementioned requirements, as well as the Agency costs for the RA system as found in the Site's AOC and O&M Plan. The O&M costs for third FYR are as follows:

Table 4 – Annual System Operations/O&M Costs

Time Period (organized by year)	**Cost** (rounded to nearest $1K)
4th Quarter 2006	$248,000
All of 2007	$664,000
All of 2008	$633,000
All of 2009	$790,000
All of 2010	$855,000
All of 2011	$660,000
1st Quarter 2012	(a)

Note: (a) Data is not available at this time.

As summarized in the MRAC's "Fourth Five-Year Performance Report, Solid State Circuits, Inc. Superfund Site, Republic, Missouri" dated September 30, 2011, O&M efforts and costs have been increasing in recent years for several reasons, including routine and non-routine repairs and replacements of components, as well as increases in the cost of sending treated water to the Republic's POTW. However, with very few exceptions, these maintenance issues have not prevented the groundwater pump-and-treat system from meeting the hydraulic control measures specified in the CD/SOW.

In addition to the operating RA system, MRAC submitted a proposal to use of a horizontal well as an innovative technology to assist in the remediation of the TCE contamination found in the UFSB on July 15, 1997. The horizontal well was installed north to south along Main Street in 2001, tested, and deemed operational. An Explanation of Significant Differences was signed in September, 2004, formally adding the horizontal well to the selected remedy. The horizontal well was in continuous operation until the December 8, 2011 fire.

During the fourth FYR period, site visits and sampling events found the on-site and off-site monitoring and groundwater pump and treat systems well maintained and in good operating condition. The exterior of the extraction and monitoring wells were well maintained, labeled, and protected (bumpers where needed). The groundwater pump and treat building and all groundwater pump and treat system components were also well maintained and in proper working order. Equipment, piping, and valves were properly labeled. Site documents such as the O&M manual, design documents, and maintenance records were all readily available. Sampling events demonstrated that the site personnel were capable of operating the groundwater pump and treat facility.

Until the December 8, 2011 fire at the extracted groundwater pump and treat system facility, the long-term O&M for the Site included the continuous operation of the groundwater pump and treat system, ongoing monitoring and reporting of these activities, and periodic review of Republic's well construction ordinance. The last revision of Republic's well construction ordinance Ord. No. 05-68 §1 was August 22, 2005. The Agencies had an opportunity to review and comment on the ordinance before it was finalized. The Agencies determined that the Republic well construction ordinance was still protective of human health and the environment.

Since the December 8, 2011 fire, the debris within the extracted groundwater pump and treat system building was removed from the building, the building along with a small storage shed were torn down and the materials were segregated, characterized and properly disposed off-site. Besides the concrete footprint of the extracted groundwater pump and treat facility building, a medium-sized permanent storage building and a temporary Baker tank remain on-site. All fire impacted utility lines and the fence were capped or repaired.

V. Progress since the Last Five-Year Review

The protectiveness statement provided in the third FYR is as follows:

> *"Based upon available data, the assessment of this (Third) FYR found the remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup standards. Currently, all threats at the SSC site have been addressed through hydraulic and institutional controls of the groundwater contamination. While the remedy is operating as intended, two issues require further assessment: vapor intrusion and plume delineation."*

Four issues were identified in the third FYR. It was determined that two of the four issues did not have a current effect on the protectiveness of the remedy; however, they could have a future effect on the protectiveness of the remedy. It was determined that the potential to affect the

current or future protectiveness of the remedy could not be determined for the other two issues until more information had been collected and analyzed prior to making a final determination. The issues, recommendations, and a summary of the completed follow-up actions are summarized below (refer to the previous FYR for more information).

A. **Issues Potentially Affecting Future Protectiveness**

1. Siltation of extraction well SSC-30. Determine the impact of siltation on remedy performance and effectiveness. Potential solutions include but are not limited to: install a new well with deeper pump intake, install a new casing, and screen inside the existing well.

   This issue was resolved. The accumulation of silt within SSC-30 was removed by MRAC in November 2008. A new screen was placed within the existing damaged screen, and the pump intake was reset to its original depth (Figures 5 and 6). The figures show the original and modified construction of extraction well SSC-30.

2. Potential leak in water supply line in the vicinity of extraction well SSC-30. Assess the impact of the leaking/potentially leaking water line in the vicinity of extraction well SSC-30; provide an evaluation in terms of remedy, performance, and effectiveness; and provide recommendations for mitigating or eliminating ancillary issues stemming from the water line leak.

   This issue was resolved. Republic's City Utilities located and repaired a small leak in the water supply line along Main Street in May 2007, while the Springfield's City Utilities located a leak in the water supply line along Main Street in February 2008. Republic's City Utilities repaired the leak in the water supply line in March 2008. Since the repair, the volume of water extracted by SSC-30 has decreased, while the concentration of the VOC contaminants in the extracted water has increased, reflecting the actual (undiluted) VOC contaminant concentrations in groundwater. This repair has improved the performance and effectiveness of the remedy by improving plume capture and reducing the amount of "clean" water being unnecessarily treated. Figure 7 shows the location of the leak, while Figure 8 shows the TCE concentration trends before and after the leak was repaired.

   In March 2008, MRAC determined that no other recommendations were generated for addressing ancillary issues stemming from the water line leak. As part of this FYR, the Agencies determined the potential exists for additional treatment of the UFSB.

B. **Issues Lacking Information to Make Protectiveness Determination**

3. (a) Confirmation of appropriate coverage by the institutional controls designed to protect against exposure to contaminated groundwater; (b) delineation of TCE at or below the MCL in the UFSB and SBR: Determine the most effective means for confirming the appropriateness and size of the institutional control coverage area; Conduct a downgradient private well survey and install new monitoring wells to enhance plume delineation between SSC-30 and SSC-31.

(a) The issue of institutional controls (ICs) is mostly resolved. For the fourth FYR the institutional controls (ICs) related to the Site were evaluated by MRAC and the Agencies. The following local and state ICs currently exist: city of Republic Ordinance No. 05-68 §1 and Missouri's 10 CSR 23-3.100(3) "Sensitive Area C" designation.

1. The city of Republic Ordinance No. 05-68 §1 (08-22-05) was established in accordance with the ROD as an IC due to site-related VOC contaminant impacts, especially TCE. The Ordinance requires that any application for a water well that is deeper than 300 feet and within Republic's 1988 City Limits must be approved by the Department / Hazardous Waste Program, and it further restricts groundwater use near the Site by prohibiting the installation of any water wells, cisterns or other groundwater production facilities. The depth requirement and location prevents the spread of VOC contamination, especially TCE, within the Ozark Aquifer (DBR).

   The last revision of Republic's well construction ordinance Ord. No. 05-68 §1 was August 22, 2005. The Agencies had an opportunity to review and comment on the ordinance before it was finalized. The Agencies determined that the Republic well construction ordinance was still protective of human health and the environment.

2. Missouri's "Sensitive Area C" designation was established in 1993 to address and protect the rapid urbanization of Greene and Northern Christian Counties and the sensitive geological nature (karst) of the Springfield Plateau Aquifer (UFSB and SBR). It requires that all drinking water wells be cased to a minimum of 10 feet below the Northview Shale, thus eliminating exposure to the UFSB and SBR. The Department must approve the proposed casing depth of each well before initiation of drilling activities.

Recommendation for ICs: As a further safeguard, the Department with the EPA's concurrence is recommending that an environmental covenant under the Missouri Environmental Covenants Act (MoECA) be placed only on the Site property at this time. The covenant will be recorded with the property's chain-of-title and notify prospective buyers of land use limitations and the property's environmental condition.

(b) The issue of the delineation of TCE in the UFSB and SBR is partially resolved. Additional temporary monitoring wells were installed and sampled north of SSC-30 as part of the 2010 Supplemental Site Investigation (SSI), as discussed below in Section VII. However, the plume delineation south of SSC-30 still needs to be done and MRAC has decided not to install any new monitoring wells between SSC-30 and SSC-31 as part of the Area 1 Pilot Study. As stated by MRAC in the January 24, 2012 meeting, the focus of the Area 1 Pilot Study is to fully define and remediate the Area 1 on-site soils.

Recommendation for the delineation of TCE in the UFSB and SBR: Before the next FYR or Site Close-Out, additional work should be completed to verify the pathways of the VOC contaminant plumes in the UFSB and SBR between SSC-30 and SSC-31.

4. Vapor intrusion pathway. Continue evaluation of the vapor intrusion pathway; possible paths include but are not limited to soil gas samples, indoor air monitoring, plume delineation, and modeling.

   This issue was partially resolved. In June and July 2007, the MRAC conducted a soil gas survey using Gore-Sorber modules. The purpose of the survey was to assess the potential for vapor intrusion into nearby buildings along Main Street between the Site and SSC-30, since these areas were suspected to contain some residual contaminated soil at depth. The Gore-Sorber modules were installed in a grid pattern along and east of Main Street, from the groundwater pump and treat system building southward to extraction well SSC-30. The results of the survey showed TCE and 1,1,1-trichloroethane (TCA) detections within the fence surrounding the groundwater pump and treat building and extending south approximately 75 feet towards the remaining vacant building (future Area 1) and west across Main Street, and a detection of TCE near CW-1 and SSC-30 (Figures 10 and 11).

   Based on the results of the passive soil vapor survey, the Department sent a May 30, 2008 letter to the MRAC stating in part "the Agencies agree that additional vapor sampling is not needed at this time due to the current results obtained from the Gore Sorber Soil Vapor Survey and lack of impacted receptors. However, the Agencies remind MRAC that if conditions change in the future, such as the revitalization of Republic near the Site, then additional data may need to be obtained to verify current and future human health risk." (Note that while this activity occurred prior to issuance of the third FYR report, the results were not available in time to be evaluated in the third FYR.)

   Recommendation: Before the next FYR, future land use changes or site Close-Out, MRAC should conduct a quantitative evaluation of vapor intrusion into buildings on both sides of Main Street along the Main Street Fracture System to SSC-31 and at the former day-care facility across Elm Street. The quantitative data could then be used in a human health risk assessment to determine current and future risk.

C. Issues and Changes Since the Third Five-Year Review

The Site experienced personnel changes towards the end of the third FYR and into the beginning of the fourth FYR. In October 2005, the site's original consultant was replaced and Environmental Works, Inc. (EWI) was chosen in May 2006. In June 2007, the Agencies were notified that the Site's operating parent company had merged with another, creating the current operating parent company. The merger lead to the replacement of the site's original legal counsel with another in June 2008 and the site's original Project Manager with another in August 2008. The new EPA Project Manager, Mr. Dan Gravatt, began in May 2009.

In addition to addressing the four issues identified in the third FYR, MRAC and the Agencies worked through a number of issues during the fourth FYR. These included conducting additional investigations of CW-1, a Force Majeure/Excusable Delay situation (March 2008) due to severe weather events in January and February 2008, and conducting the Supplemental Site Investigation (SSI) in 2010 to further delineate potential soil contamination. Current issues

include the implementation of the approved June 2012 Pilot Project Work Plan for Area 1 under the June 2012 Force Majeure/Excusable Delay Agreement, to remediate additional on-site and off-site contaminated soil sources, the aftermath of the December 8, 2011 fire that totally destroyed the on-site groundwater pump and treat facility, and the on-going Force Majeure / Excusable Delay situation (December 2011) due to the destruction of the site's current remedy, the groundwater pump and treat system.

V. Five-Year Review Process

A. Administrative Components

The fourth FYR was completed through combined efforts of the Agencies, the City of Republic, MRAC and the operating contractor, EWI. The Department Project Manager for the Site, Candice McGhee, was designated as the primary author of the fourth FYR, with comment and approval by the EPA Remedial Project Manager, Dan Gravatt.

The review schedule included the following components:

- Community Involvement
- Document Review
- Data Review
- Site Sampling and Inspection
- Local Interviews (operating contractor) and
- FYR Report Development and Review.

B. Community Involvement

Since the Site is located in a mainly commercial/industrial area with the local government a few blocks away, community involvement is limited. However, a notice was placed in the local newspaper, the *Republic Monitor* on August 24, 2011 announcing the commencement of the fourth FYR for the site (Attachment F). The announcement indicated that site-related information could be found in the local informational repository at the Springfield/Greene County Library, Republic Branch Library in Republic, Missouri.

An Information Sheet was completed in September 2011. The Information Sheet briefly describes the Site, the reasons for the Fourth FYR, the location of documents and contact information (Attachment G).

On March 6, 2012, a site inspection was conducted for the fourth FYR by the Agencies and EWI. As part of the community outreach the director of Republic's Planning & Economic Development Department was contacted and agreed to discuss the site with us at her office. A number of issues were discussed and questions were answered. The director of Republic's Public Works Department also stopped by her office during the meeting and briefly discussed public works issues of concern related to the site. Overall, the interviews were very informative.

The day care facility was in operation the day of the Site fire on December 8, 2011. Attempts were made to contact the day care facility across Elm Street and just north of the Site in mid-February 2012 after the site inspection's schedule was established. Telephone calls revealed that the day care facility's telephone number had been disconnected. Visits by EWI personnel were unable to locate anyone. On March 6, 2012, the day of the FYR site inspection, three visits failed to contact anyone. Republic's City Planner was unaware of the status of the day care facility when asked during our interview.

The warehouses directly across Main Street and just west of the Site were empty and up for sale/lease. Since the inspection was conducted on a work day, no one appeared to be home in the homes and multiplexes along Main and Elm Streets.

When the fourth FYR for the Site is complete, the Department will place a copy of the Fourth FYR Report in the local information repository in Republic. The Department will send to the local newspaper, *Republic Monitor,* a notice announcing completion of the Fourth FYR Report, the results of the review, its location at the local information repository, the Springfield/Greene County Library, Republic Branch Library and the availability of the report for review by the public.

C. Document Review

Historical and current documents including the RI and FS reports, the Baseline Human Health and Screening Ecological Risk Assessments, the Record of Decision (ROD), the Consent Decree/Statement of Work (CD/SOW), sections of the 100% Remedial Design Document Package (RDDP), the Explanation of Significant Differences (ESD), the Supplemental Site Investigation (SSI) Report, MRAC's Fourth Five-Year Performance Report, quarterly hydraulic performance reports and annual chemical monitoring reports from 2007 through 2011, the Department split groundwater sampling results, and other relevant documents were reviewed. These documents provided information and data necessary to complete the Fourth FYR Report. The relevant documents used during the fourth FYR are provided at the end of this report in "References" and "Relevant Documents Reviewed."

To determine whether the remedy chosen and implemented for the Site was still protective of human health and the environment, current state and federal regulatory standards were reviewed in relation to the Applicable or Relevant and Appropriate Requirements (ARARs) identified for the Site and the contaminant compliance levels based on those ARARs. Also using past and current sampling data, the EPA conducted internal reviews and provided recommendations in memoranda titled *Ecological Five-Year Review Technical Assessment, Republic, Missouri*, January 18, 2012, *Review of Solid States Circuits for Five Year Review*, February 9, 2012, and *Five-Year Review Technical Assessment, Solid State Circuits, Republic, Missouri*, March 30, 2012. The Missouri Department of Health and Senior Services completed a comment letter (March 19, 2012) reviewing the "*Fourth 5-Year Risk Performance Report for the Solid State Circuits, Inc. Superfund Site,* Republic, Missouri (September 30, 2011)," the "*Supplemental Site Investigation* dated January 7, 2011 (revised April 20, 2011)" and the "*Gore Sorber® Soil Vapor Survey Report* dated August 28, 2007," and an additional comment letter (March 29, 2012)

related to "updates on values related to human health." The relevant documents used during the fourth FYR are provided at the end of this report in "References" and "Relevant Documents Reviewed."

D. Data Review

As required by the CD/SOW, the responsible party, MRAC, is required to submit quarterly hydraulic performance reports and annual or five-year reports summarizing groundwater and hydraulic monitoring data collected during the year or every five years. The quarterly, annual and five-year reports were reviewed to determine compliance with performance requirements identified in the CD/SOW, assess progress in attaining the remedial goals, and to determine if there were any issues that would call into question the protectiveness of the remedy.

Since the December 8, 2011 extracted groundwater pump and treat facility fire occurred after the MRAC "Fourth Five-Year Review Report (September 30, 2011)," it was not included in the MRAC report. However, the aftermath of the December 8, 2011 groundwater pump and treat facility fire will be discussed in future MRAC reports.

The summary of findings from the review are as follows:

- Hydraulic performance criteria defined in the CD/SOW were consistently met for all three hydrogeologic systems (UFSB, SBR and DBR).
- Downtime performance criteria were consistently met for all three hydrogeologic systems, except as waived:
    - For REM-1 and SSC-30 as part of the CW-1 extended packer testing during July – August 2006,
    - For SSC-29 and SSC-30 as a result of Supplemental Site Investigation testing activities between November 2009 and March 2010 pumping cessation test,
    - For REM-1 as a result of severe weather (tornado and ice storms) experienced between January and February 2008 (Force Majeure/Excusable Delay situation) and
    - For the Site as a result of the December 8, 2011 on-site extracted groundwater pump and treat facility fire (Force Majeure/Excusable Delay situation).
- The TCE concentrations were below 200 µg/L for all sewer discharges, as required by the CD/SOW. However, TCE analytical results at the Broad Street sewer discharge location ranged from below the laboratory reporting limit (RL) of 1.0 µg/L to 22.4 µg/L, and were influenced by seasonal precipitation events. Concentrations at Broad Street were indicative of hydraulic conditions at UFSB remedial extraction well SSC-31.
- Discharge rate to the sewer was consistently maintained below 200 gpm, as required by the CD/SOW.
- TCE concentrations from the treatment system effluent (T-2-E) were consistently below laboratory RLs, as required by the CD/SOW, with the exception of two detections above the RL and below the MCL in March 2006 and July 2006 (3.06 µg/L and 3.21µg/L). The reported TCE concentrations have never exceeded the 200 µg/L limit.
- TCE concentrations exceeded the laboratory reporting limit for the POTW influent (TPI) of 1.49 µg/L in February 2008.

- Since the beginning of the RA, an estimated 81 gallons of TCE has been recovered.
- The rate of TCE removal from the three hydrogeologic systems has been declining over time, as is typical for pump-and-treat systems.
- Additional soil source material was discovered beneath the Site (Area 1) and along Main Street (Areas 2 and 3) as part of the 2010 Supplemental Site Investigation (SSI).
- On December 8, 2011, an on-site fire totally destroyed the extracted groundwater pump and treat facility including the operating groundwater pump and treat equipment and the building housing the equipment.

The discussion below summarizes the location and amounts of TCE contamination detected from 2007 through December 2011 (Attachment C). The figures, located in Attachment C, are from MRAC's "Fourth Five-Year Performance Report" and are included to show TCE concentration trends since January 1993. Since TCE is the primary COC at the Site, it will be discussed in detail here. Occurrences of other COCs are summarized more generally at the end of this section.

DBR System

The DBR System includes the extraction well REM-1, monitoring wells SSC-2B, SSC-3B, SSC-4B, and SSC-6B, and municipal wells CW-1, CW-3, CW-4, CW-5 and CW-6. In 1996, CW-1's status changed to a post-closure monitoring well, per the CD/SOW. In May 2012, CW-1 was fully closed and abandoned. CW-2 was abandoned and closed for reasons not associated with the Site. Based on the sampling data collected during the fourth FYR, the following observations were made:

- TCE concentrations in extraction well REM-1 ranged from 15.3 µg/L (2010) to 26.0 µg/L (2008) (Figure 2-6). To provide updated cleanup time frames based on current data, regression analyses were applied to REM-1 (Table 5). Based on the trends, regression analyses indicated that an additional 43 years are needed to reach the MCL.
- TCE concentrations in monitoring well SSC-3B ranged from 1.1 µg/L (2010) to 3.2 µg/L (2007).
- TCE was not detected in monitoring wells SSC-2B, SSC-4B, and SSC-6B during the fourth FYR.
- TCE was not detected in the Republic/Brookline municipal wells CW-3, CW-4, CW-5 or CW-6. On June 20, 2007, CW-6 went online in the consolidated Republic-Brookline area. Annual sample collection began on CW-6 in October 2007.

Based on chemical data collected to date, the DBR produced diminishing contaminant returns during the Fourth FYR period.

SBR System

The SBR System includes the extraction wells REM-2 and SSC-6C, and monitoring wells SSC-1A, SSC-3A, SSC-4A and SSC-23. Based on the sampling data collected during the fourth FYR, the following observations were made:

- There are no SBR monitoring locations providing data that could be used to define a clean southern boundary of the plume.
- TCE concentrations in extraction well REM-2 ranged from 1,910 µg/L (2009) to 5,800 µg/L (2008) (Figure 2-12).
- TCE concentrations in extraction well SSC-6C ranged from 2,200 µg/L (2009) to 10,400 µg/L (2010) (Figure 2-13).
- Historically, TCE concentrations in REM-2 were generally lower than SSC-6C (Figures 2-12 and 2-13). To provide updated cleanup time frames based on current data, regression analyses were applied to REM-2 and SSC-6C (Table 5). Based on the trends, regression analyses indicated that an additional 144 years (REM-2) and 78 years (SSC-6C) are needed to reach the MCL. The calculated time frame does not account for contaminant rebound as noted during the SSI, which could extend the calculated time frame.
- TCE concentrations in monitoring well SSC-3A ranged from 7.56 µg/L (2006) to 55.2 µg/L (2007) (Figure 2-14). The contaminant impacts to SSC-3A may be a result of its proximity to the Main Street Fracture System (MSFS) and well construction. Based on the possibility that a higher conductive unit may exist at depths of approximately 175 to 210 feet bls, EWI proposed an additional downhole characterization for SSC-3A.
- TCE was not detected in monitoring wells SSC-1A, SSC-4A, and SSC-23.

Based on chemical data collected to date, the SBR produced diminishing contaminant returns during the Fourth FYR period.

UFSB System

The UFSB System includes the extraction wells SSC-29, SSC-30 and SSC-31, the monitoring wells SSC-09, SSC-11, SSC-13, SSC-20, SSC-23, SSC-24, SSC-26, SSC-27 and SSC-32, and the discharge sampling locations for the Horizontal Well and Roberts Spring. For discussion purposes, the UFSB plume is divided into the North Portion (area near SSC-29), Middle Portion (area near SSC-30), and South Portion (area near SSC-31). Based on the sampling data collected during the fourth FYR, the following observations were made:

- There are no UFSB monitoring wells providing data that could be used to define a clean southern boundary of the plume.
- Part of the groundwater treatment plant effluent was discharged to the horizontal well in lieu of discharge to the sewer. TCE was not detected in the discharged treated groundwater.
- SSC-18 is located along Main Street between SSC-30 and SSC-31 and only three sampling events were conducted on this well. TCE concentrations in SSC-18 ranged from <1.0 µg/L (2009 and 2010) to 21.4 µg/L (2006).
- TCE contamination was not detected in sample results from Roberts Spring.

For the remaining discussion, the UFSB plume is divided into the North Portion (area near SSC-29), Middle Portion (area near SSC-30) and South Portion (area near SSC-31).

North Portion:

- TCE concentrations ranged in extraction well SSC-29 from 574 µg/L (2009) to 2,660 µg/L (2008) (Figure 2-20).
- TCE concentrations ranged in monitoring well SSC-11 from 694 µg/L (2007) to 1,470 µg/L (2010) (Figure 2-21).
- TCE concentrations in extraction well SSC-29 and monitoring well SSC-11 remained relatively stable (Figures 2-20 and 2-21). To provide updated cleanup time frames based on current data, regression analyses were applied to SSC-29 and SSC-11 (Table 5). Based on the trends, regression analyses indicated that an additional 43 years (SSC-29) and 15 years (SSC-11) are needed to reach the MCL. The calculated time frame does not account for contaminant rebound as noted during the SSI, which could extend the calculated time frame.
- TCE concentrations in monitoring well SSC-13 ranged from 14 µg/L (baseline sampling event) to 277 µg/L during the extent of SSI testing. Since the SSI, TCE concentrations were 121 µg/L (April 2010) and 100 µg/L (October 2010). The increased TCE concentrations during the SSI might be due to the operational cessation of extraction well SSC-29 and the Horizontal Well during the SSI.

Middle Portion

- TCE concentrations ranged in extraction well SSC-30 from 41.6 µg/L (2006) to 950 µg/L (2008). The TCE concentration variations were impacted mostly by external events (Figure 2-22). After the initiation of the one-year horizontal well pilot test, TCE concentrations ranged from 41.6 µg/L (2006) to 291 µg/L (2007). Following the repair of a city of Republic water main leak in March 2008, TCE concentrations ranged from 274 µg/L (2009) to 950 µg/L (2008) due to the removal of "clean water" dilution near SSC-30.
- Monitoring wells SSC-20, SSC-24, and SSC-32 are located near SSC-30. TCE concentrations in SSC-20 ranged from 467 µg/L (2010) to 19,800 µg/L (2010) and exhibited the highest TCE concentrations within the UFSB (Figure 2-23). The higher TCE concentrations at SSC-20 may be due to a smaller screened interval and/or the screened interval location. TCE concentrations in SSC-24 ranged from 50.2 µg/L (2010) to 1,460 µg/L (2007) and the TCE concentrations in SSC-32 ranged from 140 µg/L (2010) to 268 µg/L (2007) (Figures 2-24 and 2-25).
- Monitoring wells SSC-12 and SSC-21 are also located near SSC-30; however, only three sampling events were conducted on these wells. TCE concentrations in SSC-12 ranged from 315 µg/L (2006) to 3,280 µg/L (2010), while the TCE concentrations in SSC-21 ranged from 104 µg/L (2010) to 506 µg/L (2006).
- To provide updated cleanup time frames based on current data, regression analyses were applied to SSC-30, SSC-20, SSC-24 and SSC-32 (Table 5). Based on the trends, regression analyses indicated that an additional 76 years (SSC-30), 201 years (SSC-20), 257 years (SSC-24) and 86 years (SSC-32) are needed to reach the MCL. The calculated time frames do not account for contaminant rebound as noted during the SSI, which could extend the calculated time frames. In addition, the SSI sample results indicate that these calculated cleanup time frames may be even longer due to the existing soil impact acting as source material for the dissolved plume in this area.

South Portion

- Groundwater pumped from extraction well SSC-31 is discharged to the Broad Street Sewer. TCE concentrations in the Broad Street Sewer ranged from 2.2 µg/L (2010) to 22.0 µg/L (2008) (Figure 2-27). The data continued to demonstrate the seasonal variability previously documented for this well (Figure 2-26). Based on these trends, regression analyses indicate that an additional 39 years are needed to reach the MCL at SSC-31 (Table 5).
- SSC-26 and SSC-27 are located near SSC-31. TCE concentrations for SSC-26 ranged from 2.6 µg/L (2010) to 16.0 µg/L (2008), while the TCE concentrations for SSC-27 ranged from <1.0 µg/L (2009 and 2010) to 5.5 µg/L (2008).
- To provide updated cleanup time frames based on current data, regression analyses were applied to SSC-31, SSC-26, and SSC-27 (Table 5). Based on the trends, regression analyses indicated that an additional 39 years (SSC-31) and 27 years (SSC-26 and SSC-27) are needed to reach the MCL. Since the TCE concentrations within this area are highly variable and dependent upon seasonal conditions, the realistic cleanup time frames will likely extend further than the time frames calculated on Table 5.

Table 5 – Timeframes to Reach MCLs

Well ID	Years to Reach MCL (2010)	Year MCL is Reached (Regression Analysis)
REM-1	43	2036
REM-2	164	2157
SSC-6C	98	2091
SSC-29	93	2086
SSC-30	76	2069
SSC-31	39	2032
SSC-11	65	2058
SSC-20	201	2194
SSC-24	257	2250
SSC-26	27	2020
SSC-27	27	2020
SSC-32	86	2079

Note: Generated from Table 2-17, MRAC Fourth FYR document

Based on the chemical data collected to date, the TCE concentrations either stabilized or exhibited sporadic trends during the Fourth FYR period.

TCE breakdown daughter products including both the cis- and trans- isomers of 1,2-dichloroethylene (1,2-DCE) and vinyl chloride (VC) have been found at the site, are generally found in the same wells that contain TCE, and generally follow concentration trends similar to that of TCE. For example, TCE concentrations in extraction well SSC-6C ranged from 2,200 µg/L (2009) to 10,400 µg/L (2010), while 1,2-DCE ranged from 2,000 ug/L in 2009 to 6,830 ug/L in 2010 in this well. 1,2-DCE has been detected repeatedly above its MCL in all extraction wells in the SBR and UFSB, and repeatedly below its MCL in the DBR extraction well REM-1.

Vinyl chloride (VC) has been detected sporadically below and slightly above its MCL of 2 ug/L in several SBR and UFSB wells including REM-2, SSC-6C, SSC-11, SSC-24 and SSC-32. The maximum concentration of VC during this FYR period was 6.61 ug/L in SSC-6C in 2006.

1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), and 1,1,1-trichloroethane (1,1,1-TCA) have been detected in many SBR and UFSB wells during this FYR period. 1,1-DCE has been detected both below and above its MCL of 7 ug/L at concentrations up to 137 ug/L in SSC-6C in 2010. 1,1,1-TCA detections have been below its MCL of 200 ug/L.

Soil Gas Data

A Gore-Sorber soil gas survey was conducted in June 2007 and discovered elevated soil gas concentrations of TCE and 1,1,1-TCA in several Sorbers located in the central, southern, and southwestern portions of the Site. One detection of TCE was found south of the Site near CW-1. These results are discussed in more detail in the responses to Questions B and C below.

Soil Data

The 2010 SSI discovered three areas of soil contamination: one at the Site itself, largely in the central and southwest area; and two other areas south of the Site near CW-1. These areas correlate with the locations identified by the 2007 Gore-Sorber survey and have been designated Areas 1, 2 and 3 respectively. It is believed that these soil source areas are still contributing VOCs to the groundwater. These areas will be addressed with interim measures in the form of pilot studies that use in-situ chemical oxidation, and possibly other technologies, to destroy the contaminants in the soil. The SSI results are discussed in more detail in the responses to Questions B and C below.

E. Site Inspection

On December 8, 2011, the Site experienced an early morning on-site fire. A limited Site Inspection of the Site was conducted on December 8, 2011 by DNR to assess the damage caused by the fire. Inspection personnel included Republic and Springfield fire fighters, a representative from the State Fire Marshal's Office, the Department Project Manager, a MRAC representative and numerous personnel from the operating contractor, EWI. A copy of the State Fire Marshal's Office report is located in Attachment B.

The December 8, 2011 post-fire inspection revealed that the fire had totally destroyed the on-site extracted groundwater pump and treat facility, which included the operating groundwater pump and treat equipment, all housed documents and the building that housed the equipment and documents. The debris on the main room concrete floor consisted of the destroyed computer terminal, the two air stripper shells with associated control panel, piping, ducts and motors, documents, roof trusses and decking, singed shingles and insulation, and a heating unit. The debris on the secondary room concrete floor consisted of the destroyed equalization tank and associated piping, a storage cabinet, singed shingles and insulation, and a heating unit. Since the main room's concrete floor was recessed, standing water was also evident.

The FYR Site Inspection was completed on March 6, 2012. Representatives of the FYR team and the site inspection participants included the Agencies and two personnel from the operating contractor, EWI. A list of participants is included at the end of the Site inspection checklist located in Attachment E. The inspection included the Site proper, extraction and monitoring wells, Roberts Spring, the Republic/Brookline municipal wells, and the former daycare (Kidzone) facility.

The FYR site inspection for the Site was conducted three months after the December 8, 2011 fire. After the standing water in the extracted groundwater pump and treat system facility building was collected and containerized, the debris and rubble was removed and the remaining walls were torn down to the concrete floor. As the materials (water, debris, rubble and walls) were removed, they were segregated, characterized and properly disposed off-site. A small permanent storage building that was in poor shape was torn down and properly disposed off-site. All the damaged landscaping around the groundwater pump and treat facility building was also properly disposed off-site.

The remaining structures and wellheads at the Site were found to be in good condition. The concrete floor from the groundwater pump and treat facility building was evident and clear of all impediments. All piping and electrical connections not totally destroyed by the fire were capped off. No site-related documents, such as the O&M manual, design documents and maintenance records, were on-site; however, site-related documents and reports were evident and readily available during previous visits to the EWI Springfield offices. On-site groundwater extraction and monitoring wells and the horizontal well appeared not to be impacted by the fire. There was a medium-sized permanent storage building and a temporary Baker tank on-site. The Baker tank will temporarily store all collected purge and sampling water until it can be sampled and properly disposed. The remaining landscaping not damaged by the fire was well maintained.

The fence damage by the December 8, 2011 fire was also repaired. Otherwise, no significant damage to fence was evident. The low hanging branch noted in the last inspection was gone, thus preventing easy access to the Site. The fence has barbed wire along the top including the gates. The walk-in and drive through gates were locked and secured before and after the inspection. Notification signs were evident on all four sides of the Site.

The day care facility (Kidzone), which was just north and across Elm Street is now out of business. It appears to have closed at some time between the December 8, 2011 site fire and early February 2012.

The off-site portion of the inspection included inspecting off-site groundwater extraction, monitoring and the Republic/Brookline municipal wells and Roberts Spring. All visited wells were in good repair and clearly marked. Roberts Spring was active and nicely landscaped. Fish and insects were evident.

F. Interviews

Interviews with two city of Republic department directors were conducted in conjunction with the Site Inspection, as discussed in Attachment E. The operating contractor, EWI, provided

information to the Department and the EPA representatives regarding operation and maintenance of the Site after the December 8, 2011 fire. Any substantive issues identified during the interviews are discussed further in Section VII.

G. Other issues

The December 8, 2011 on-site fire created a Force Majeure situation due to the total destruction of the operating remedy, since the operation of most of the on-site and off-site groundwater extraction and monitoring wells and the horizontal well were operated and controlled from the on-site groundwater pump and treat system facility building. Sitewide operations and responses from multiple locations were recorded and documented by the on-site computer terminal housed in the facility building.

Due to the fire, MRAC requested a Force Majeure/Excusable Delay situation on December 16, 2011 under Section XX "Force Majeure/Excusable Delay" of the 1990 Consent Decree. On December 29, 2011, the Agencies granted the Force Majeure/Excusable Delay request due to the total destruction of the operating destruction by the fire. A meeting was held on January 24, 2012 to discuss the path forward for the Site. The Agencies and MRAC signed an "Agreement for Additional Reasonably Necessary Time Regarding Force Majeure/Excusable Delay" (FM/ED Agreement) in June 2012, which requires MRAC to perform pilot projects at soil source areas 1, 2, and 3, and the preparation of a focused feasibility study to recommend any necessary changes to the original selected remedy as documented in the September 1989 ROD.

As a result of the fire, the procedures for conducting groundwater and surface water monitoring and sampling were revised as outlined in the February 9, 2012 letter to MRAC. The biggest change as outlined in the letter was changing from automatic and manual monitoring and sampling to strictly manually monitoring and sampling. Also, all extracted groundwater/surface water will be containerized (Baker tank) and characterized before proper disposal.

The recently discovered soil source areas (Areas 1, 2 and 3) potentially represent a continuing source of VOC contamination leaching to groundwater that may be partially responsible for delaying achievement of the cleanup goals. The December 8, 2011 fire caused the total destruction of the operating remedy, so at present it is not possible to maintain or achieve the groundwater cleanup goals of the remedy. A planned pilot project remediation of the three soil source areas and a modified groundwater monitoring plan has been incorporated into the Force Majeure/Excusable Delay (FM/ED) Agreement. Under the FM/ED Agreement, the assessment of the effectiveness of the soil source areas remediation and the groundwater/surface water monitoring/sampling will determine the current status of the remedy.

VII. Technical Assessment

The FYR process includes questions that provide a framework to determine if the selected remedial action is still protective of human health and the environment. Since previous response actions conducted in 1984 were thought to have fully addressed the contaminated on-site soils and debris, the ROD only addressed the contaminated groundwater. This FYR report is based on data, information and/or conclusions presented before the December 8, 2011 groundwater pump

and treat system facility fire. Discussions regarding the December 8, 2011 groundwater pump and treat system facility fire can be found in Section VI. G. Current state and federal regulatory standards were reviewed in relationship to the ARARs identified for the site and contaminant compliance levels based on these ARARs.

As part of the fourth FYR, a *Human Health Technical Assessment* was completed by the Missouri Department of Health and Senior Services (DHSS) and the EPA Region VII Human Health Risk Assessors. Questions B and C were addressed as part of both *Human Health Technical Assessments.*

Also part of the fourth FYR, an *Ecological Technical Assessment* was completed by the EPA Region VII Ecological Risk Assessor. Questions B and C below were addressed as part of the *Ecological Technical Assessment.*

Question A: Is the remedy functioning as intended by the decision documents?

Answer A: No

Remedial Action Performance

During the fourth FYR period, the site's four RAOs were reviewed and compared to the chemical data to determine if the operating RA would meet the RAOs in the foreseeable future. The chemical data indicates a continued asymptotic trend in the DBR, SBR, and UFSB extraction and monitoring wells. The asymptotic trends in the site's wells do not equate to meeting the site's RAO in the foreseeable future, especially to "restore the contaminated groundwater for future use by reducing the contaminant concentrations to regulated or health-based levels."

The RA monitoring and extraction (groundwater pump and treat) systems continued to operate as designed and were functioning properly. The groundwater pump and treat system operated within established design parameters and maintained the downtime performance requirements to meet the established criteria during the fourth FYR. Hydraulic performance criteria, such as drawdown and rolling average annual levels, established in the CD/SOW or modified and approved by the Agencies were met for all three hydrogeologic aquifers, and the sewer discharge limits were also met.

Of the three RA monitoring and extraction (groundwater pump and treat) systems, only the DBR monitoring wells were able to provide chemical data that could define a clean southern plume boundary. There were no SBR monitoring wells able to provide chemical data that could be used to define a clean southern plume boundary. The contaminant levels in the UFSB extraction and monitoring wells exhibited the most notable change in contaminant levels between the middle and furthest group of wells. Since the furthest UFSB extraction and monitoring wells on the leading edge of the contaminant plume remained contaminated, there were no UFSB wells able to provide chemical data that could be used to define a clean southern plume boundary.

The continued contamination of the SBR and UFSB sentinel extracting and monitoring wells during the fourth FYR, questions the ability of the RA systems to "prevent potential exposure to contaminated groundwater" and/or to "protect the uncontaminated groundwater for future use by preventing further migration of the contaminated groundwater plumes." Even though the southern sentinel extraction and monitoring wells remained contaminated in the SBR and UFSB during the fourth FYR period, no TCE or other VOC contaminants have impacted known water supplies or surface water bodies.

The original estimated time frame for remedy completion was a forty-year RA schedule. Based on the data and analysis completed, the attainment of the RA groundwater cleanup levels is proceeding more slowly than estimated. Although contaminant concentrations were reduced, it is likely that ongoing contaminant loading from the soil source areas and other, as yet not delineated bedrock source areas are impacting and re-contaminating the groundwater. Even with the planned treatment of the soil source areas, the uncertainties created by the soil source areas and the total destruction of the groundwater pump and treat facility by the December 8, 2011 fire could potentially impact the ability of site to maintain or achieve the intended cleanup levels within the originally estimated timeframes.

System Operations/Operation & Maintenance (O&M)

The ongoing operating procedures implemented at the Site included the operation of the monitoring and groundwater pump and treat systems and the ongoing reporting of these activities. These procedures during the fourth FYR period continued to provide for effective response action under O&M. Additionally, routine and non-routine repairs and replacements of components have increased in recent years due to the age of the monitoring and extraction systems and weather related damage. However, with very few exceptions, these maintenance issues have not prevented the monitoring and extraction systems from meeting the hydraulic control and performance requirements as outlined in the ROD and the CD/SOW.

During the fourth FYR, site visits and sampling events found the monitoring and groundwater pump and treat systems in good operating condition and the groundwater pump and treat facility building and grounds well maintained. Extraction and monitoring wells, equipment, piping, and valves were in good working order and properly labeled. Site documents such as the O&M manual, design documents, and maintenance records were all readily available. Sampling events demonstrated that site personnel were capable of operating the groundwater pump and treat facility.

Since the December 8, 2011 fire, the debris within the groundwater pump and treat facility building was removed, and the building and a small storage shed were torn down. All materials were properly disposed off-site. All fire impacted utility lines were capped and the fence was repaired.

As per the "Agreement for Additional Reasonably Necessary Time Regarding Force Majeure/Excusable Delay" (FM/ED Agreement) that the Agencies and MRAC signed in June 2012, the RA groundwater pump and treat facility was not immediately reconstructed after the

fire. However, for continued protection of human health and the environment procedures were outlined for conducting groundwater and surface water monitoring and sampling in a February 9, 2012 letter to MRAC.

Costs of System Operations/Operation & Maintenance

O&M costs increased in recent years due to increased routine and non-routine maintenance, repairs/replacements of components, weather-related destruction, utility costs, sewer rate increases to send treated water to the Republic's POTW, and innovative technology costs.

- The increased RA maintenance costs resulted from the need to replace equipment that had reached the end of its service life. These activities were expected and were not indicative of poor maintenance or abnormal deterioration of materials.
- Unanticipated maintenance due to extreme weather conditions such as ice storms and tornadoes were common and costly.
- Maintenance associated with the reconstruction of SSC-30 and the Republic municipal water main leak was costly.
- Utility costs increased due to the increase in the disposal rate of the treated water (per gallon) at the POTW. Since 2006, the disposal rate increased 150 percent with additional sewer rate increases planned for 2012.
- Innovative technology costs increased due to efforts made towards remedy optimization and evaluating additional RA.

Overall, the increase in costs as a result of these activities does not indicate a fundamental problem with the system operations or O&M.

Opportunities for Optimization

When the RA was implemented, very few remedial action alternatives existed for VOC contamination in groundwater. Since then other techniques have been developed that assist in optimizing containment and remediation of VOC contamination in groundwater and soil. In order to reduce the remaining operational life of the RA and possibly achieve the site's RAOs and cleanup goals in a timelier manner, MRAC and the Agencies have explored some other optimization techniques.

Along with delaying the immediate reconstruction of the RA groundwater pump and treat facility after the fire, site optimization will be conducted under the June 2012 FM/ED Agreement. The FM/ED Agreement includes the requirement to conduct a "Focused Feasibility Study" that will allow MRAC and the Agencies to explore some other optimization techniques to improve the current RA and potentially allow the achievement of the site's RAOs and clean-up goals in a timely manner.

- Options for optimization would require additional site characterization. The information and data gathered could be applied to any and all of the following options of optimization or to any other option of optimization. The Supplemental Site Investigation (SSI) was conducted in 2009 – 2010 and identified the three areas of remaining soil source contamination.

- A possible option for optimization is the implementation of chemical amendments, such as chemical oxidation, to address remnant areas of soil source contamination. On June 13, 2012, the Agencies approved the Pilot Project Work Plan (PPWP) to remediate the remaining on-site soil source area (Area 1) using chemical oxidation. Work is planned to begin in the summer of 2012.

- A possible option for optimization is enhanced bioremediation. Sampling data indicate daughter products, such as cis-1,2-DCE and vinyl chloride, are found in the on-site and off-site groundwater monitoring wells and their existence indicates that TCE is degrading. This degradation process could be enhanced to assist in the site's remediation. Over the last five years EWI collected additional groundwater parameters to determine site conditions for bioremediation. The Supplemental Site Investigation (SSI) was conducted in 2009 – 2010.

- If MRAC conducts soil and vapor intrusion sampling, then existing locations (hot spots) of contamination in soil could be determined. The removal/remediation of all remaining contaminated soils would eliminate the remaining soil source areas. The Gore Sorber® Soil Vapor Survey was conducted in June and July 2007 and the Supplemental Site Investigation (SSI) was conducted in 2009 – 2010. On October 13, 2010, the Agencies received the Pilot Project Work Plan (PPWP) to remediate the remaining on-site soil source area (Area 1) using chemical oxidation. The PPWP was approved in June 2012 and work began in June 2012.

- Another option for optimization could include an evaluation of the operation of the extraction wells in the DBR, the SBR, and the UFSB to determine if anything could be changed, such as the location of the extraction pumps within the wells, the duration of operation per quarter or the extraction rate, and possibly the need for new extraction wells to optimize the extraction of the contamination in groundwater.

Any of these suggested optimization strategies, singularly or in combination, and/or other strategies could prove beneficial at reducing the time required to meet the site's RAOs. As discussed below, the Agencies and MRAC began working together to determine a course of action to reduce the time needed to remediate the site.

Supplemental Site Investigation (SSI)

The Supplemental Site Investigation (SSI) was conducted in 2009 - 2010 to evaluate the potential for enhanced in-situ bioremediation (EISB) in the highly impacted groundwater plume; and install additional groundwater monitoring wells to define the contaminant plume between the Site and SSC-30. EISB was evaluated to determine its potential to treat the highly impacted UFSB groundwater plume by deploying several microbe "traps" in existing monitoring wells. The traps were augmented with a carbon source. Results indicated that under controlled conditions microbes flourish within the traps and have the potential to degrade TCE and other VOC contaminants. Six temporary monitoring wells were installed along the MSFS between the Site and SSC-30. Data from these wells helped refine plume boundaries in this area.

Early Indicators of Potential Remedy Problems/Issues

Non-Attainment of Remedy Completion Timeframe

The original RA schedule estimated a forty-year timeframe for remedy completion. Based on current analyses, the estimated timeframe to reach completion of the groundwater remedy under the current performance trends ranges from 15 to more than 100 additional years, depending on the aquifer system being evaluated (UFSB, SBR or DBR) and the particular monitoring well data trend that is considered. It appears that contaminant source areas at the Site and the possible need for changes in the groundwater pump and treat (extraction) system may be contributing to slower remedial progress than expected. Before the next FYR, a number of issues will be explored to better define the Site and determine the best approach to remediate the Site.

Limits of Plume Delineation in SBR and UFSB

The limits of the SBR and the UFSB contaminant plumes may not be fully defined by the existing groundwater monitoring well network as indicated by the available chemical data. SSC-3A is the southernmost SBR monitoring well. During the fourth FYR period, TCE concentrations ranged from 7.56 µg/l (2006) to 55.2 µg/l (2007) with the October 2010 value at 19.9 ug/l. The southernmost UFSB monitoring wells are SSC-26 and SSC-27. During the fourth FYR period, TCE concentrations for SSC-26 ranged from 2.6 µg/l (2010) to 16.0 µg/l (2008) with the October 2010 value at 9.5 ug/l, while the TCE concentrations for SSC-27 ranged from <1.0 µg/l (2009 and 2010) to 5.5 µg/l (2008) with the October 2010 value at 3.3 ug/l.

Although the remedy appears to be effective at reducing the TCE concentrations near these wells, it is uncertain how far south the contaminant plumes extend, especially in the UFSB and SBR. It is recommended that before the next FYR, the UFSB and SBR monitoring well networks be extended to fully define the contaminant plumes with clean sentinel monitoring wells at the leading edge.

CW-1 Abandonment and Closure

Republic's municipal well No. 1 (CW-1) was taken out-of-service with the discovery of TCE contamination between July 1983 and March 1984. CW-1 was used during the RI as an off-site DBR monitoring well and later as an extraction well. As part of the ROD, CW-1 was included as the off-site DBR extraction well. After the first FYR, CW-1 began post-closure activities as described in the CD/SOW.

Analytical data collected during post-closure sampling events indicated the casing was compromised and allowed contamination from the UFSB/SBR to migrate downward through the well into the DBR. A packer was installed in CW-1 to isolate the UFSB/SBR cased section from the DBR open-hole section, allowing the DBR portion of CW-1 to meet post-closure requirements for abandonment.

MRAC submitted a Closure and Abandonment Plan in 2011 that the Agencies approved on September 21, 2011. Problems occurred during the abandonment and closure of CW-1, so only a

partial abandonment and closure of the DBR section (below the Northview Shale (DBR)) attained on November 8, 2011. Work continued until CW-1 was fully grouted and abandoned in May 2012.

Sample for 1,4 Dioxane

Recently the EPA has stressed the importance of determining the presence of 1,4-dioxane (dioxane) in older groundwater sites with 1,1,1-TCA contamination. Dioxane is a colorless liquid (ether) that is very harmful in the vapor phase. Dioxane is mainly used as a stabilizer for the storage and transport of 1,1,1-TCA in aluminum containers. Dioxane is highly soluble in water, does not readily bind to soils and readily leaches to groundwater. It is also resistant to biodegradation processes. Due to these properties, a dioxane plume is often much larger and further downgradient than the associated 1,1,1-TCA plume. As part of the ongoing groundwater monitoring, a minimum of two consecutive sampling events at key extraction and monitoring wells should be conducted to determine the presence or absence of dioxane. The status of dioxane could be used to help assess the effectiveness of the remedy.

Implementation of Institutional Controls and Other Measures

Controls such as fencing, warning signs, and caps and locks are also avenues to prevent casual access to the monitoring and extraction systems and other components of the RA. Access to extracted groundwater is restricted to authorized EWI personnel and Republic's water and POTW operators. Currently all these controls are in good condition. No other actions appear necessary at this time.

Implementation of Institutional Controls (ICs)

As part of the fourth FYR, institutional controls (ICs) related to the Site were reviewed and evaluated by the Agencies and MRAC. Besides the Site being on the EPA NPL (06/10/1986) and the Missouri *Registry* (02/22/1985), there exists a Republic Ordinance No. 05-68 §1 (last revised 08-22-05) (local IC) and a Missouri 10 CSR 23-3.100(3) "Sensitive Area C" designation (state IC).

The Republic Ordinance No. 05-68 §1 (08-22-05) was established in accordance with the Site's ROD as a local IC due to site-related VOC contaminant impacts, especially TCE. The Ordinance requires that any application for a water well that is deeper than 300 feet and within Republic's 1988 City Limits (surrounded by Anderson Street, West Avenue, Miller Road, and Hampton Avenue) must be approved by the Department/Hazardous Waste Program, and the Ordinance further restricts groundwater use near the Site by prohibiting the installation of any water wells, cisterns or other groundwater production facilities. The depth requirement and location prevents the spread of VOC contamination, especially TCE, within the Ozark Aquifer (DBR). When the well construction ordinance is revised, the Agencies have an opportunity to review and comment on the ordinance before it was finalized. The Agencies determined that the Republic well construction ordinance (revised 08-22-05) was still protective of human health and the environment.

The Missouri "Sensitive Area C" requires that all drinking water wells installed in this Area (all of Greene County where Republic is located) be cased a minimum of 10 feet below the Northview Shale. Since the UFSB and SBR lie above the Northview Shale, this IC prevents any new wells from being installed in a way that would allow exposure to contaminants in the UFSB and SBR to the DBR.

Before the next FYR, a number of issues will be explored to define the VOC contaminant plumes within the three groundwater aquifers and define the vapor intrusion plume. The Agencies recommend an evaluation of other ICs be done to determine if an additional IC such as an environmental covenant should be placed on the Site property. The covenant would be recorded with the property's chain-of-title and notify prospective buyers of land use limitations and the property's environmental condition. If it's determined the vapor intrusion plume(s) have migrated under other buildings/properties and can't be remediated, then an environmental covenant should be placed on that property to notify prospective buyers of land use limitations and the property's environmental condition.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Answer B: Yes.

The target populations, exposure assumptions, routes and pathways, site characteristics and land use, the toxicity data, the RA contaminant cleanup levels, the ARARs and other standards, and the RAOs are still valid. The impact of the recent reassessment of TCE toxicity is unlikely to have a significant impact on risk since the toxicity value changes by only an order of magnitude. The implications of changes in TCE toxicity values will be addressed when evaluating vapor intrusion.

Changes in Standards and To Be Considered(s) (TBCs)

Have there been any changes to the risk-based cleanup levels or standards identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the Record of Decision (ROD) that call into question the protectiveness of the remedy?

Human Health Considerations

Chemical-specific ARARs for the contaminants of concern (COCs) detected in groundwater were discussed and summarized in the 1989 ROD. Only groundwater COCs and their cleanup levels were established for the Site since contaminated soil and debris were excavated in all areas exceeding risk-based action levels for commercial/industrial use.

The chemical-specific ARARs are based on Federal MCLs, Missouri Maximum Inorganic and Volatile Organic Chemical Contaminant Levels (MO MCLs) and Missouri Water Quality Standards (MO WQSs) in groundwater. As shown in Table 6, several MCLs for the tabulated COPCs have changed since the September 1989 ROD. The MO MCLs and MO WQSs closely mirror the Federal MCLs and are current.

Table 6 - 1989 ROD Cleanup Levels versus Current MCLs

COPCs Identified in 1989 ROD	1989 ROD Cleanup Levels (mg/l)	Current MCLs (mg/l)	COPCs Identified in 1989 ROD	1989 ROD Cleanup Levels (mg/l)	Current MCLs (mg/l)
Acrolein	NA	NA	1,3-Dichloropropylene	NA	NA
Benzene	0.005	0.005	Ethylbenzene	0.7	0.7
Bis(2-Ethylhexyl) phthalate	NA	0.006	Isophorone	NA	NA
Butyl Benzyl Phthalate	NA	NA	Methyl Chloride	NA	NA
Chlorobenzene	0.06	0.1	Methylene Chloride	NA	0.005
Chloroethane	NA	NA	Phenol	NA	NA
Chloroform	0.1	0.08	PCE	0.005	0.005
1,1-DCA	0.005	NA	Toluene	2	1
1,1-Dichloroethylene	0.007	0.007	1,1,1-TCA	0.2	0.2
1,2-DCA	0.005	0.005	TCE	0.005	0.005
cis-1,2-DCE	NA	0.07	1,1,2-TCA	NA	0.005
trans-1,2-DCE	0.07	0.1	Vinyl Chloride	0.002	0.002
1,2-Dichloropropane	0.005	0.005			

In addition to the chemical-specific ARARs, action-specific ARARs selected at the time of the remedy are still valid. As long as the ICs remain in place to prevent potable well installation in or near the contaminant plume(s) and provided the contaminant plume(s) are captured and not reaching a classified water body (where ambient water criteria apply), the exposure pathways to contaminated groundwater remain incomplete.

Ecological Considerations

Chemical-specific ARARs for groundwater are based on the Federal MCLs, MWQSs, and the Federal MCLGs. Missouri Drinking Water Criteria are available for two contaminants (ethylbenzene and phenol). Although water quality criteria are not available for all site-related contaminants, other ecological benchmarks for surface water can be used. These values are not ARARs; however, they do provide a means for determining potential ecological risk. The lack of a value implies that a contaminant is not being evaluated for potential ecological risk, which can be problematic.

Table 7 provides ecological screening levels for surface water in Roberts Spring. The majority of the values are based on the EPA Region V Ecological Screening Levels (ESL) (EPA, 2003). However, a National Ambient Water Quality Criteria (NAWQC) is available for Acrolein (EPA, 2009); therefore, that ecological screening level (ESL) value is provided. ESL values based on Suter and Tsao (1996) are provided for contaminants that do not have Region V ESLs. Overall, sampling data indicates that the spring water in Roberts Spring is not impacted by site-related contaminants; however, the detection limits for Acrolein are above the NAWQC.

Table 7 - Region V Ecological Screening Levels

Contaminant	ESL (µg/L)	Contaminant	ESL (µg/L)
Acrolein	3[1]	1,2-Dichloropropane	360
Benzene	114	1,3-Dichloropropylene	244[2]
Bis(2-ethylhexyl) Phthalate	912[2]	Ethylbenzene	320
Butyl Benzyl Phthalate	23	Isophorone	920
Chlorobenzene	47	Methyl Chloride	42,667[2]
Chloroethene (Vinyl Chloride)	930	Methylene Chloride	940
Chloroform	140	Phenol	100
1,1-DCA	47	PCE	45
1,1-DCE	65	Toluene	253
1,2-DCA	910	1,1,1-TCA	76
cis-1,2-DCE	970[3]	TCE	47
trans-1,2-DCE	970	1,1,2-TCA	500

Notes:
1-Value based on National Ambient Water Quality Criteria (EPA, 2009).
2-Value based on Suter and Tsao (1996).
3-Surrogate value is provided. Trans-1,2-Dichloroethylene is used as a surrogate for cis-1,2-Dichloroethylene.

Are there newly promulgated standards that call into question the protectiveness of the remedy?

Federal MCLs are now available for several COPCs and COCs that were not available at the time of the 1989 ROD (Table 6). However, the newly promulgated standards since the time of the ROD do not call into question the protectiveness of the remedy.

Chemical-specific ARARs and TBCs were identified in the Appendix A of the ROD and included: Federal 40 CFR 141 (safe drinking water standards), Missouri 10 CSR 60.4 (drinking water standards), Missouri 10 CSR 20.7 (water quality standards), and Federal ambient water quality standards for aquatic life protection. These numeric criteria are established to protect human health from ingestion of contaminants in groundwater and surface water, and from ingestion of potentially contaminated aquatic organisms. Numeric criteria also included acute and chronic ambient water quality levels for protection of aquatic life.

As the remedy progresses towards restoring the three groundwater hydrologic aquifers to pre-contamination conditions, the same ARARs that were valid when the remedy was chosen will need to be met when the groundwater is considered fully remediated. Note that numeric values for inorganics, total chromium, copper, lead, mercury, nickel, and zinc, along with all organics detected in groundwater during the RI, were listed in the ROD and initially identified for monitoring. However, the Remedial Design Report concluded that the remedial discharge fluids were insignificant components of the sewer systems fluids that entered the POTW, the levels measured during remedial design were below the federal and state drinking water standards, and therefore no pretreatment of fluids from the Site was required. Eliminating inorganics from the groundwater monitoring program was approved by Department in a letter dated February 14, 1990. Current numeric values for these criteria have been compiled and are provided in Table 6 and note new values for TCE.

Action-specific ARARs selected at the time of the remedy are still valid, and no additional ARARs or TBCs have been identified.

Have TBCs used in selecting cleanup levels at the site changed in a way that could affect the protectiveness of the remedy?

The local and state ICs, city of Republic Ordinance No. 05-68 §1 and Missouri's 10 CSR 23-3.100(3) "Sensitive Area C" designation, were established and incorporated into the 1989 ROD. The local ordinance prohibits the construction of new water supply wells in or near the contaminant plumes until the remediation is complete. This will prevent direct contact and/or ingestion of contaminated groundwater. As long as the ICs remain in place, any changes in the TBCs will allow the exposure pathways to remain incomplete.

Changes in Exposure Pathways

Have any human health or ecological routes of exposure or receptors changed or been newly identified (e.g., dermal contact where none previously existed, new populations or species identified on site or near the site) that could affect the protectiveness of the remedy?

Vapor intrusion was identified as an additional exposure pathway during the Third FYR. In June and July 2007, MRAC conducted the *Gore Sorber® Soil Vapor Survey* to assess the potential for vapor intrusion into nearby buildings along Main Street between the Site and SSC-30, since these areas were suspected to contain some residual contaminated soil. The Gore-Sorber modules were installed in a grid pattern along and east of Main Street, from the groundwater pump and treat facility building southward to SSC-30. The area surveyed did not underlie any structures. The survey revealed TCE and 1,1,1-TCA detections on-site within the fenced area surrounding the groundwater pump and treat facility building and extending west across Main Street and south approximately 75 feet towards the remaining vacant building (Area 1). TCE was detected around CW-1. Although a survey was conducted using Gore-Sorber modules, no sub-slab or indoor air samples were collected for any surrounding structures.

Given the volatility of contaminants at the Site, the shallow depth to groundwater, and the proximity of occupied buildings to the UFSB and SBR plumes, including residences, apartment complexes and a day care facility, further evaluation of the vapor intrusion exposure pathway is recommended following vapor intrusion guidance (USEPA, 2002; ITRC, 2007).

It is recommended that a quantitative evaluation, including sub-slab vapor sampling and indoor air samples, be collected on both sides of Main Street, where occupied surface structures exist, along the Main Street Fracture System to SSC-31 and at the former day-care facility across (northward) Elm Street. The quantitative data could then be used in a human health risk assessment to determine current and future risk and determine whether or not the current remedy is protective of this potential exposure pathway.

The Supplemental Site Investigation (SSI) conducted in 2009 – 2010 revealed three soil source areas, one on-site and two off-site. Area 1 is located on-site west (past the fence line) and south

(past the fence line) of the groundwater pump and treat facility building, at depths ranging from approximately 7 feet bsg down to bedrock. Two smaller soil source areas (Areas 2 and 3) were discovered under and along Main Street near SSC-13, and near and south of SSC-30. The soil source areas generally agree with data from the Gore-Sorber survey.

Enhanced in-situ bioremediation (EISB) was evaluated as part of the SSI to determine its potential to treat the highly impacted the groundwater plume by deploying several microbe "traps" in existing monitoring wells. The traps were augmented with a carbon source. Results indicated that under controlled conditions, microbes flourish within the traps and have the potential to degrade TCE and other contaminants in the Site's groundwater.

Six temporary monitoring wells were installed during the SSI along the MSFS between the Site and SSC-30. Data from these wells helped refine plume boundaries in this area. EWI proposed to install additional, permanent monitoring wells along the contaminant plume as part of a future work plan.

MRAC proposed a pilot test of in-situ chemical oxidation (ISCO) for Area 1. Extensive groundwater and surface water monitoring will be needed to verify soil and groundwater remediation. The Pilot Project Work Plan for this ISCO test was approved June 13, 2012. Fieldwork began in the summer of 2012.

No new ecological routes of exposure or ecological receptors (new populations or species) were identified during the fourth FYR period.

Changes in Land Use

Has land use or expected land use on or near the site changed (i.e., industrial to residential, commercial to residential)?

During the FYR period, land use at the Site and the surrounding area has not changed and the Agencies are not aware of any potential future land use changes on-site or near the site. Up until January 2012, a daycare facility was located just north and across Elm Street. If another daycare facility should move in, this could be considered a land use change. The warehouses directly west and across Main Street are currently empty. If rented or sold, the use of the buildings could potentially change. Single family homes and multiplexes exist south and east of the site. These should remain as residential, so their land uses potentially will not change. No new buildings have been built over the plume.

However, the land use potentially changed with the December 8, 2011 fire since the main on-site building that housed the groundwater pump and treat (pump and treat operation equipment) facility was destroyed and is no longer viable. Based on the results of proposed soil source area remediation, the footprint of a future remediation system (modified remedy) may change, thus impacting future land use.

New Contaminants and/or Contaminant Sources

Are there newly identified contaminants or contaminant sources?

The SSI that was conducted in 2009-2010, identified a soil source area west of the groundwater pump and treat system building, extending under and around several of the monitoring and extraction wells in this area and down to bedrock. Two smaller source areas were also discovered, one near SSC-13 and one near SSC-30. TCE was detected at a depth of 7.5 to 8 feet at the on-site sample location SSC-41 (3,060 mg/kg). If the on-site and off-site soil contamination is not remediated, then controls should be put in place to prevent future exposure to construction and utility workers since it is assumed that construction workers will come into direct contact with soils down to a depth of 10 feet bsg with a bulk of their exposures to subsurface soil during excavation.

Have physical site conditions or the understanding of these conditions changed in a way that could affect the protectiveness of the remedy?

We have no information to show that site conditions or the understanding of these conditions has changed. However, there has been a recent focus nationwide on the vapor intrusion to indoor air pathway, especially on sites with TCE contamination. Vapor intrusion can pose health concerns for occupants of buildings with basements, with slab-on-grade and with crawl spaces. The current EPA Vapor Intrusion guidance (November 2002) evaluates the vapor intrusion pathway and identifies steps for screening sites that may be of concern. Among the steps are: identifying sites with contaminants of sufficient volatility and toxicity; identifying sites with occupied buildings located within 100 feet vertically or horizontally of subsurface contamination; and comparing site data to media-specific target levels.

Given the volatility of contaminants at the Site, the shallow depth to the water table (approximately 10 feet bsg), and the proximity of occupied buildings to the UFSB/SBR plumes (included among these a day care center, homes, and apartment complexes), further evaluation of this exposure pathway was conducted through a Gore-Sorber survey in 2007. The Gore-Sorber survey identified a limited area of soil gas impacts to the west and southwest of the on-site groundwater pump and treat facility building, and this area did not underlie any adjacent structures. Soil sampling conducted during the SSI in 2010 identified previously unknown soil source areas of contamination, suggesting that the soil gas results were due to the presence of contaminated soil. A quantitative vapor intrusion study of the surrounding area conducted according to current EPA guidance is warranted.

While there have been no changes in site conditions that create new exposure pathways, a day care center was located immediately north of the site across East Elm Street. This brings a sensitive receptor population near the site and creates a potential for outdoor air exposure. An evaluation of the discharge height for the air stripper was completed to determine if there is a potential for impacting the center. To ensure that VOC emissions from groundwater treatment did not result in an exposure pathway at the day care center, the groundwater pump and treat facility only pumped the most contaminated wells at night. The nightly pumping was sufficient to maintain the requirements set forth in the CD/SOW.

No new contaminants and/or contaminant sources for ecological receptors were identified during the fourth FYR period.

Remedy Byproducts

Are there unanticipated toxic byproducts of the remedy not previously addressed by the decision documents (e.g., byproducts not evaluated at the time of the remedy selection)?

The Agencies are not aware of any unanticipated toxic byproducts of the remedy not previously addressed by the decision documents.

Changes in Toxicity and Other Contaminant Characteristics

Have toxicity factors for the contaminants of concern at the site changed in a way that could affect the protectiveness of the remedy?

Several toxicity factors have changed since the baseline human health risk assessment was conducted in June 1989 (Tables 8 and 9). A revised TCE risk assessment completed in 2010 determined that TCE is a human carcinogen and significantly revised its toxicity and slope factor calculations. Cleanup levels for groundwater are based on the MCLs; however, the MCL for TCE has not changed as of the date of the fourth FYR. There are now inhalation toxicity values for evaluating cancer and non-cancer adverse health effects that were not previously available. During the fourth FYR period, the Agencies were not aware of any other changes in the toxicity values for the COCs.

The Reference Concentration (RfC) methodology to estimate benchmark values for noncancer toxicity (adverse health effects other than cancer and gene mutations) of inhaled chemicals significantly differs from the Reference Dose (RfD) approach. Although the same general principles were used, the RfC methodology was expanded to account for the dynamics of the respiratory system as the portal of entry. The major difference between the two approaches, therefore, is that the RfC methodology includes dosimetric adjustments to account for the species-specific relationships of exposure concentrations to deposited/delivered doses. The approach outlined in *RAGS, Part A* was developed before EPA issued the *Inhalation Dosimetry Methodology*, which describes the Agency's refined recommended approach for interpreting inhalation toxicity studies in laboratory animals or studies of occupational exposures of humans to airborne chemicals.

The derivation of the noncancer toxicity values in Table 8 followed the original RAGS approach (*RAGS, Part A*) to derive the inhalation reference concentrations (earlier terminology was "inhalation reference dose" or "RfDi"), which was typically derived in terms of a chronic, daily "air intake" (mg/kg-day). The Superfund Program has since updated its inhalation risk paradigm to be compatible with the *Inhalation Dosimetry Methodology*, which represents the Agency's current methodology for inhalation dosimetry and derivation of inhalation toxicity values. This document recommends that when estimating risk via inhalation, risk assessors should use the concentration of the chemical in air as the exposure metric (e.g., mg/m^3), rather than inhalation intake of a contaminant in air based on intake rate (IR) and body weight (BW) (e.g., mg/kg-day).

The intake equation described in *RAGS, Part A, Exhibit 6-16* is not consistent with the principles of EPA's *Inhalation Dosimetry Methodology* since the amount of the chemical that reaches the target site is not a simple function of IR and BW. The equation is therefore not recommended for estimating exposures to inhaled contaminants. *RAGS, Part F* replaces those portions of *RAGS, Part A* which addressed inhalation risk. Accordingly, the noncancer toxicity information presented in Table 8 should be updated in accordance with the methodology prescribed in *RAGS, Part F* as follows:

Table 8 - Noncancer Toxicity Values Used in 1989 and Available in 2012

	VALUES USED IN 1989				VALUES AVAILABLE IN 2012			
	Reference Doses				Reference Doses			
Chemical	Oral (mg/kg/day)	Ref.	Inhalation (mg/kg/day)	Ref.	Oral (mg/kg/day)	Ref.	Inhalation (mg/kg/day)	Ref.
1,1-Dichloroethane	1.2E-01	NCEA	1.38E-01	IRIS	2.0E-01	PPRTV	NA	NA
1,1-Dichloroethene	9.0E-01	Health Effects Publ.	-		5.0E-02	IRIS	2.0E-01	IRIS
trans-1,2-Dichloroethene	1.0E-02	NCEA	-		2.0E-02	IRIS	6.0E-02	PPRTV
Methylene Chloride	6.0E-02	Health Effects Publ.	-		6.0E-02	IRIS	6.0E-01	IRIS
1,1,1-Trichloroethane	9.0E-02	Health Advisory	3.0E-01	SPHEM	2.0E+00	IRIS	5.0E+00	IRIS
Trichloroethene	7.4E-03	HEAST	-		5.0E-04	IRIS	2.0E-03	IRIS
Vinyl Chloride	1.3E-01	Health Advisory	-		3.0E-03	IRIS	1.0E-01	IRIS

CalEPA = California Environmental Protection Agency
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NCEA = National Center for Environmental Assessments
PPRTV = Provisional Peer Reviewed Toxicity Values
ATSDR = Agency for Toxic Substances and Disease Registry

It should be noted that the *Inhalation Dosimetry Methodology* typically is also used in developing an inhalation unit risk (IUR) for cancer risk assessment (which may also be called an inhalation cancer slope factor). The cancer toxicity information presented in Table 9 should similarly be updated in accordance with the methodology prescribed in *RAGS, Part F* as follows:

Table 9 - Cancer Toxicity Values Used in 1989 and Available in 2012

Chemical	VALUES USED IN 1989				VALUES AVAILABLE IN 2012			
	Cancer Slope Factors				Cancer Slope Factors			
	Oral $(mg/kg/day)^{-1}$	Ref.	Inhalation $(mg/kg/day)^{-1}$	Ref.	Oral $(mg/kg/day)^{-1}$	Ref.	Inhalation $(mg/kg/day)^{-1}$	Ref.
1,1-Dichloroethane	9.10E-02	HEAST, NCEA	-		5.7E-03	CalEPA	1.6E-06	CalEPA
1,1-Dichloroethene	6.00E-01	IRIS	1.2	IRIS	NA	NA	NA	NA
Methylene Chloride	7.50E-03	IRIS	1.42E-02		7.50E-03	IRIS	4.7E-07	IRIS
Trichloroethene	1.10E-02	IRIS	4.60E-03	HEAST, SPHEM, Health Effects Publ.	4.6E-02	IRIS	4.1E-06	IRIS
Vinyl Chloride	2.3	SPHEM, Health Effects Publ.	1.50E+00	HEAST, SPHEM, Health Effects Publ.	7.2E-01 (during adulthood) 1.5E+0 (from birth)	IRIS	4.4E-06	IRIS

CalEPA = California Environmental Protection Agency
HEAST = Health Effects Assessment Summary Table
IRIS = Integrated Risk Information System
NCEA = National Center Environmental Assessment
SPHEM = Superfund Public Health Effects Manual

Have other contaminant characteristics changed in a way that could affect the protectiveness of the remedy?

During the fourth FYR period, the Agencies are not aware of any other changes to the contaminant characteristics.

Changes in Risk Assessment Methods

Have standardized risk assessment methodologies changed in a way that could affect the protectiveness of the remedy?

Human Health Risk Assessment

The exposure assumptions used to develop the Human Health Risk Assessment (HHRA) included both current and future exposures. The assumptions made in this review may be overly conservative, particularly under the maximum concentration scenario, and may result in an overestimation of risk. The assumptions and risk evaluation; however, have no impact on the selection of the ongoing remedial action.

The RI/FS included a HHRA and the results were documented in the ROD. The HHRA determined that "no current unacceptable health risks are present since the UFSB and SBR are

not presently used as a source of drinking water and CW-1 (DBR) was removed from service. However, future use of on-site and off-site groundwater from the three aquifers could pose unacceptable health risks."

The HHRA was conducted using the Superfund Public Health Evaluation Manual (SPHEM) (USEPA, 1986), prior to the EPA's current standardized risk assessment methodologies (i.e., Risk Assessment Guidance for Superfund [RAGS] documents). Receptor populations, contact media, and exposure pathways and assumptions still remain valid today.

While much of the methodology is the same, the process for selecting chemicals to be evaluated in the HHRA is somewhat varied. Selection of "indicator chemicals" under the old guidance tended to be more general and arbitrary, which allowed for more chemicals to be eliminated than would be eliminated using current methodology as described in the RAGS for selecting "chemicals of potential concern." However, the remedy is designed to address all VOCs and not just "indicator" VOCs. This, plus the requirement that all VOCs must meet ARARs, makes the impact of this change in methodology inconsequential.

Furthermore, several exposure parameters used in the 1989 HHRA are different than values currently used (i.e., skin surface area, soil adherence factor, etc.). Dermal contact with contaminated water while showering and bathing are currently quantified, which was not done in the 1989 HHRA, and the EPA has more recent guidance on quantifying exposure for both the dermal and inhalation routes of exposure (USEPA 2004, 2009). Overall, these changes do not have a significant impact on the conclusions of the risk assessment.

Ecological Risk Assessment

The RI/FS included a Baseline Ecological Risk Assessment (BLRA) that was completed in June 1989 and the results were documented in the ROD. The BLRA determined that "no threatened or endangered wildlife were identified." Continued urbanization in the area of the Site renders it an unattractive ecological habitat.

The RI/FS also included water and sediment sampling and dye tracing to determine the interconnection between the three groundwater aquifers and the two known downgradient surface water locations, Schuyler Creek and Roberts Spring. The sample results and dye traces determined that Schuyler Creek and Roberts Spring are downgradient surface water bodies that are in hydraulic connection with the groundwater system at the Site. Since Roberts Spring is considered the furthest downgradient surface water body or discharge point, Roberts Spring is used as the Site's monitoring location. Thus, the ecological risk at the Site is largely limited to the potential VOC contamination of Roberts Spring via the discharge of the VOC contamination in groundwater.

While the EPA has issued new guidance for conducting Ecological Risk Assessments since the BLRA was written, the initial step of the ecological evaluation process remains the same. Under problem formulation, the likelihood of exposure pathways is evaluated. The current ecological technical assessment indicates the RAOs, used at the time of the remedy selection, are still valid. The 1989 BLRA concluded that exposure opportunity and the potential for ecological risk at the

Site were minimal. The conclusions of the fourth FYR remains the same as the 1989 BLRA since no new information has come to light related to the ecological risk at the Site. If the contaminant plumes were to migrate to Roberts Spring, there may be a need to evaluate the impact to ecological receptors. However, samples at Roberts Spring continue to be non-detect for contaminants of concern.

Expected Progress towards Meeting Remedial Action Objectives (RAOs)

O&M operational efforts for the pump and treat system increased due to the age of the components; however, MRAC's efforts to maintain the integrity of the system ensured the pump and treat system's ability to meet the hydraulic control criteria until the December 8, 2011 fire.

The MRAC fourth FYR report estimated the RA is approximately 86 percent complete. However, it noted that the amount of contaminants removed from the aquifers has been decreasing with time, and contaminant levels have been dropping more slowly than in the past. Estimates for the amount of time to reach completion of the groundwater remedy under current performance trends range from 15 to more than 100 years, depending on the aquifer system being evaluated (UFSB, SBR or DBR) and the particular monitoring well data trend that is considered. Thus, progress towards the groundwater cleanup standards has slowed.

The recently discovered soil source areas of contamination potentially represent a continuing source of VOC contamination leaching to groundwater that has delayed achieving the cleanup levels. The soil source areas will be removed or otherwise treated in the near future, after which progress toward the RAOs is expected to improve. The soil source areas do not represent a new exposure pathway as the impacted soil is in the subsurface.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Answer C: Yes.

Human Health Risks

Have newly found human health risks been found?

The recently discovered soil source areas of contamination represent a continuing source of contamination to groundwater that has delayed achieving the cleanup levels; however, the soil source areas do not represent a new exposure pathway as the impacted soil is in the subsurface. It is believed that as long as the previously unknown soil source areas are not addressed, the areas will continue to impact the contaminant concentrations in the UFSB. Coupled with the discovery of the soil source areas impact is the potential of an off-site properties vapor intrusion issue within buildings along and west of Main Street and along and north of Elm Street.

O&M efforts for the pump and treat system had been increasing due to the age of the components; however, MRAC's efforts maintained the integrity of the system and ensured its ability to meet the hydraulic control criteria.

Ecological Risks

Have newly found ecological risks been found?

No ecological targets were identified during the BLRA and none were identified during the fourth FYR; therefore, monitoring of ecological targets is not necessary at this time. However, annual VOC sampling, especially of TCE, is recommended at Roberts Spring. Besides being a possible ecological target, Roberts Spring is a monitoring point to verify continued chemical quality and hydraulic performance control of the shallow aquifers.

Natural Disaster Impacts

Are there impacts from natural disasters (e.g., a 100-year flood)?

Natural disasters that impacted the Site during the fourth FYR included a number of severe weather events that ranged from extreme heat and cold, thunderstorms, snow storms, ice storms, straight line winds, and tornadoes. The severe weather caused numerous problems with the monitoring and groundwater pump and treat system operations that ranged from irregular operations due to communication errors to major physical, mechanical (REM-1's extraction pump), and electrical damage.

A series of ice storms struck southwest Missouri from November 30-December 1, 2006 and again on January 12-14, 2007. The ice storms produced thick ice that resulted in downed trees and power lines, followed by days of extreme cold. Besides the power outages, the Site experienced mechanical, electrical and landscaping damage.

Severe weather struck in January and February 2008. On January 7, 2008, a tornado caused damage to REM-1's operating equipment. The February 2008 ice storms also caused damage at the site including a downed tree across the fence and broken utility lines. The January and February 2008 severe weather events created a Force Majeure/Excusable Delay situation in March 2008 due to the extreme amount of down time (non-operation of the groundwater pump and treat facility). However, the effects of all of these weather events were temporary.

Any Other Information That Could Come to Light That Could Call into Question the Protectiveness of the Remedy?

Has any other information come to light which could affect the protectiveness of the remedy?

While the current remedy is currently protective of human health and the environment, the RAOs are unlikely to be achieved within the estimated time frames under the current RA. Modeling indicates the time frame for TCE to achieve the MCL will extend to over one hundred years or more instead of the projected 40 years (as stated in the ROD), especially in the UFSB and the SBR.

It is believed that as long as the previously unknown soil source areas are not addressed, the areas will continue to impact the contaminant concentrations in the UFSB. Coupled with the

discovery of the soil source areas impact is the potential for an off-site properties vapor intrusion issue within building along and west of Main Street and along and north of Elm Street.

The ROD's selected remedy, the groundwater pump and treat system, burned to the ground on December 8, 2011. As a result, the Site remedial action has been seriously compromised. Additional issues that came to light during the fourth FYR are the vapor intrusion pathway and the newly identified soil source areas. Previous comments were made in the "Changes in Exposure Pathway" section regarding these issues.

Summary of Technical Assessment

Based on the results of the fourth FYR, the remedy was meeting the chemical monitoring and hydraulic performance requirements as outlined in the CD/SOW and there were no known risks to human health or the environment. There are eight issues with recommendations and follow-up actions that should be addressed before the next FYR. These issues are discussed in this section and summarized in Section VIII, Issues and Section IX, Recommendations.

The December 8, 2011 fire totally destroyed the operating on-site groundwater pump and treat facility. Based on the current site situation, the EPA changed the status of the "Groundwater Under Control Environmental Indicator" for the Site to "Not Under Control" effective January 27, 2012, due to the fire and its impact on the remedial action.

VIII. Issues

Issue	Description	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1	Re-evaluate progress towards achieving RAOs	N	Y
2	Delineate horizontal and vertical limits of UFSB and SBR plumes	*	Y
3	Define vapor intrusion (VI) plume	*	Y
4	Remediate/remove soil source areas	N	Y
5	Complete Abandonment and Closure of Republic's CW-1 well	N	Y
6	Implement additional institutional controls (ICs)	N	Y
7	Assure compliance with and implementation of work required by the Force Majeure/Excusable Delay (FM/ED) Agreement	N	Y
8	Sample for 1,4-Dioxane (dioxane)	*	Y

*Potential to affect protectiveness; more data and information must be collected and analyzed prior to making a final determination.

IX. Recommendations and Follow-Up Actions

Issue	Recommendations/ Follow-Up Actions	Responsible Party	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
1	Re-evaluate progress towards achieving RAOs after cleanup / removal of soil source areas.	MRAC	Department and EPA	04/01/2015	N	Y
2	Install additional monitoring wells in UFSB and SBR to confirm horizontal and vertical plume boundaries.	MRAC	Department and EPA	04/01/2015	*	Y
3	Conduct quantitative vapor intrusion (VI) study to confirm and remediate the VI pathway.	MRAC	Department and EPA	04/01/2015	*	Y
4	Treat/remove the three VOC-contaminated soil source areas.	MRAC	Department and EPA	12/31/2014	N	Y
5	Complete the abandonment and closure of the CW-1 well to remove the vertical VOC pathway to DBR.	MRAC	Department and EPA	06/30/2012	N	Y
6	Implement additional ICs by recording an environmental covenant with the SSC property's chain of title.	MRAC	Department and EPA	06/30/2015	N	Y
7	Investigate and remediate/remove the soil source areas and continue to extract and monitor the three VOC contaminant plumes in groundwater. Complete a focused feasibility study.	MRAC	Department and EPA	12/31/2014	N	Y
8	Add sampling for 1,4- dioxane to future groundwater sampling events to determine if this contaminant is present at the Site.	MRAC	Department and EPA	06/30/2013	*	Y

*Potential to affect protectiveness; more data and information must be collected and analyzed prior to making a final determination

X. Protectiveness Statements

A protectiveness determination of the remedy cannot be made at this time until further information is obtained, due primarily to the destruction of the groundwater pump and treat system by fire in December 2011. Further data and information will be obtained by taking the following actions: completing a comprehensive vapor intrusion study of all structures overlying potentially impacted groundwater, addressing all soil source areas, delineating the contaminant plumes in all three water bearing zones and fully containing the contaminant plumes in groundwater. It is expected that these actions will take approximately 3.5 years to complete, at which time a protectiveness determination will be made.

XI. Next Review

The next (fifth) five-year review will be due in September 2017.

The trigger date for the due date of the next five-year review is the approval of this (fourth) five-year review by the EPA as demonstrated by the EPA's signature on this document.

References

City of Republic, Missouri, *City Code 710.150 – Water Regulations*, Last Amended August 2005

DuCharme, Charles B. and Miller, Todd, M., *Missouri State Water Plan Series - Volume IV, Water Use of Missouri,* MO DNR/DGLS, Water Resources Report Number 48, 1996.

Missouri Code of State Regulations, *10 CSR 20-7. Department of Natural Resources, Division 20 – Clean Water Commission*, Last Publish Date 07/31/2008.

Missouri Code of State Regulations, *10 CSR 60-4. Department of Natural Resources, Division 60 – Safe Drinking Water Commission*, Last Publish Date 10/31/03

MO Department of Conservation, *Missouri's Conservation Atlas, A Guide to Exploring Your Conservation Lands,* Jefferson City, MO, 1997.

MO, *Missouri Registry Annual Report, Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri,* Jefferson City, MO, Fiscal Year 2011.

Thompson, Thomas L., *The Stratigraphic Succession in Missouri,* MO DNR/DGLS, Rolla, MO, Revised 1995.

U.S. Department of Agriculture and Soil Conservation Service, *Soil Survey of Greene County, Missouri,* April 1985.

U.S. EPA, *Comprehensive Five-Year Review Guidance,* EPA OSWER *Directive 9355.7-03B-P*, Washington, DC, June 2001.

U.S. EPA, OSWER *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance),* 530-D-02-004, 2004.

U.S. EPA, *Ecological Risk Assessment Guidance for Superfund: Conducting Ecological Risk Assessments,* EPA/540/R-97/006, Washington, DC, June 2001.

U.S. EPA, *National Recommended Water Quality Criteria*, Office of Water, Office of Science and Technology (4303T), 2006.

U.S. EPA, *National Primary Drinking Water Standards,* Office of Water (4606M), 2006.

U.S. EPA, *Recommended Evaluation of Institutional Controls: Supplemental to "Comprehensive Five-Year Review Guidance"* OSWER Directive 9355.7-18, September 13, 2011

References (Cont'd)

U.S. EPA – Region 6, *Human Health Medium-Specific Screening Levels,* 2008.

U.S. EPA – Region 9 (EPA-R9), *Preliminary Remediation Goals Table 2004,* October 2004.

U.S. EPA, *Risk Assessment Guidance for Superfund:* Volume 1-Human Health Evaluation Manual (Part A), EPA/540/1-89/002, Washington, DC, 1989.

Vandike, James E., *Missouri State Water Plan Series - Volume I, Surface Water Resources of Missouri,* DNR/DGLS, Water Resources Report Number 45, 1995.

Relevant Documents Reviewed

The following documents were reviewed in completing the Fourth FYR:

Remedial Investigation Report, Solid State Circuits, Inc., Republic, Missouri Site, July 1989.

Feasibility Study, Republic, Missouri Site for the Solid State Circuits, Inc., Springfield, Missouri, July 1989, includes Human Health and Ecological Risk Assessments.

Solid State Circuits Site, Record of Decision, First & Final Operable Unit, including all attachments, September 29, 1989.

Consent Decree (July 26, 1990)/Statement of Work (May 31, 1990)

Volume I of the 100% Remedial Design Document Package, "Remedial Design Report" for the Republic, Missouri Site, October 5, 1992.

Volume IV of the 100% Remedial Design Document Package, "Remedial Action Groundwater Monitoring and Management Plan" for the Republic, Missouri Site, October 5, 1992.

Volume V of the 100% Remedial Design Document Package, "Remedial Action Contingency Plan" for the Republic, Missouri Site, October 5, 1992

Addendum Report to the RA Groundwater Monitoring & Management Plan for the Republic, Missouri Site, September 23, 1994.

Remedial Action Construction Documents

Remedial Action Operation and Maintenance Plan

Second Five-Year Review Report, Solid State Circuits, Republic, Greene County, Missouri September 20, 2002, Department and U.S. EPA Region VII.

Third Five-Year Performance Report for the Republic, Missouri Site, Volume I & II, September 30, 2006.

Technical Working Session, Solid State Circuits, Inc. Superfund Site, Republic, Missouri, August 28, 2007, MRAC.

Gore-Sorber® Soil Survey Report, Solid State Circuits, Inc. Superfund Site, Republic, Missouri, August 28, 2007, MRAC.

Third Five-Year Review Report, Solid State Circuits, Republic, Greene County, Missouri, September 12, 2007, U.S. EPA Region VII and Department.

Relevant Documents Reviewed (Cont'd)

Combined 2007 Annual Report and 4th Quarter Hydraulic Report for the Republic, Missouri Site, Volumes I & II, January 31, 2008, MRAC.

Combined 2008 Annual Report and 4th Quarter Hydraulic Report for the Republic, Missouri Site, Volumes I & II, January 15, 2009, MRAC.

Combined 2009 Annual Report and 4th Quarter Hydraulic Report for the Republic, Missouri Site, Volumes I & II, February 15, 2010, MRAC.

Combined 2010 Annual Report and 4th Quarter Hydraulic Report for the Republic, Missouri Site, Volumes I & II, February 15, 2011, MRAC.

Supplemental Site Investigation Report, Solid State Circuits, Inc. Superfund Site, Republic, Missouri, Volume I & II, January 7, 2011 (Revised April 20, 2011), MRAC.

Fourth Five-Year Performance Report, Solid State Circuits, Inc. Superfund Site, Republic, Missouri, Volumes I & II, September 30, 2011, MRAC.

EPA, *Ecological Fourth Five-Year Review, Solid State Circuits Site, Technical Assessment, Republic Missouri,* January 18, 2012.

Combined 2011 Annual Report and 4th Quarter Hydraulic Report for the Republic, Missouri Site, Volumes I & II, January 15 & February 15, 2012, MRAC.

DHSS, *Department of Health and Senior Services (DHSS), Comments to "Fourth 5-Year Risk Performance Report for the Solid State Circuits, Inc. Superfund Site,* Republic, Missouri (September 30, 2011)," the "*Supplemental Site Investigation* dated January 7, 2011 (revised April 20, 2011)" and the "Gore Sorber® Soil Vapor Survey Report dated August 28, 2007," March 19, 2012.

Attachment A

FIGURES


NORTH
CHECKED BY:
M. KENWORTHY
E.W.I. # 60185
DRAWN BY: MDK
JUL. 31, 2007
SCALE (FEET)
0
210
420
840
APPROXIMATE
ENVIRONMENTAL WORKS INC.
SITE LOCATION MAP
SOLID STATE CIRCUITS, INC. SUPERFUND SITE
200 S. MAIN STREET
MEXICO, MISSOURI
FIGURE
1

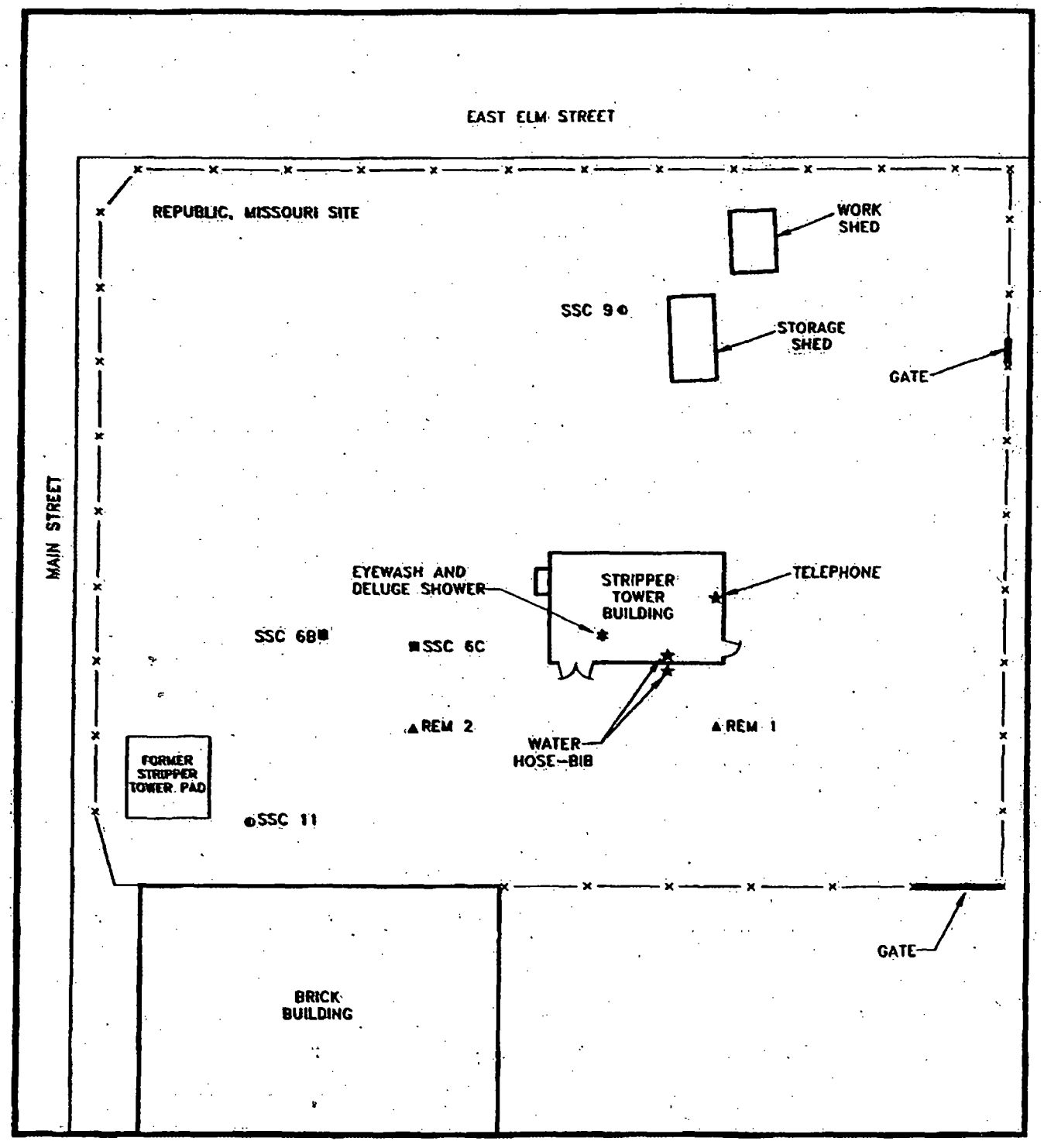


Figure 2
Site Detail Map

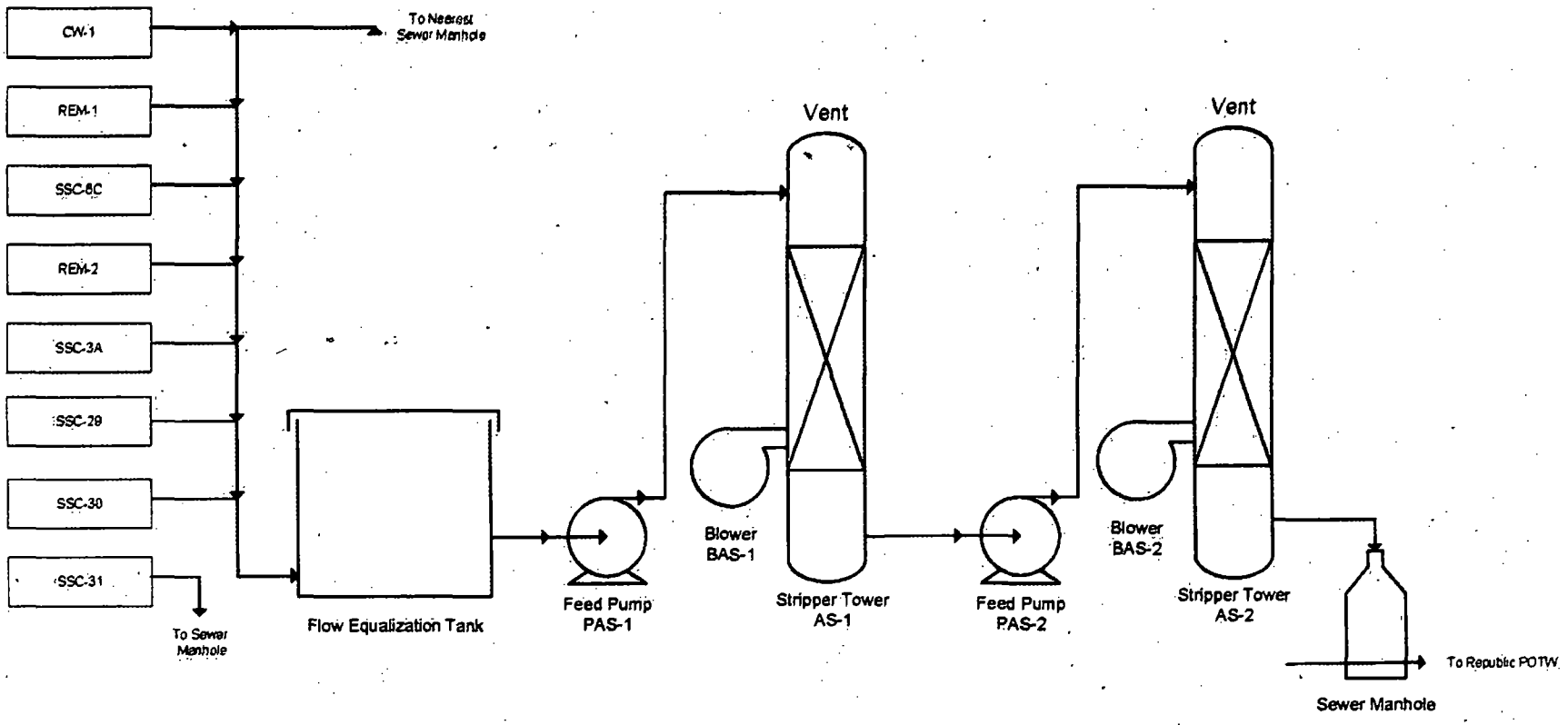
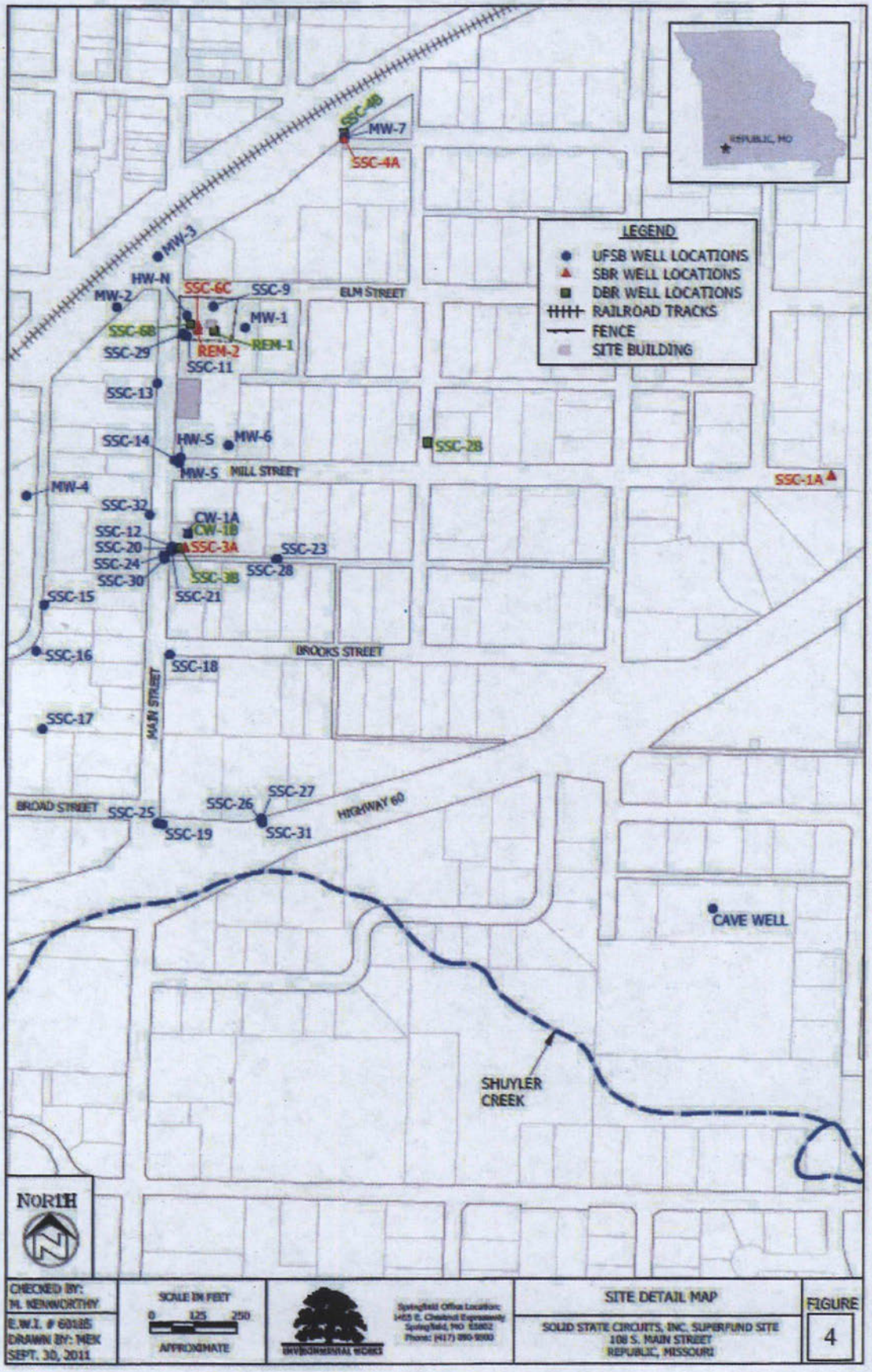
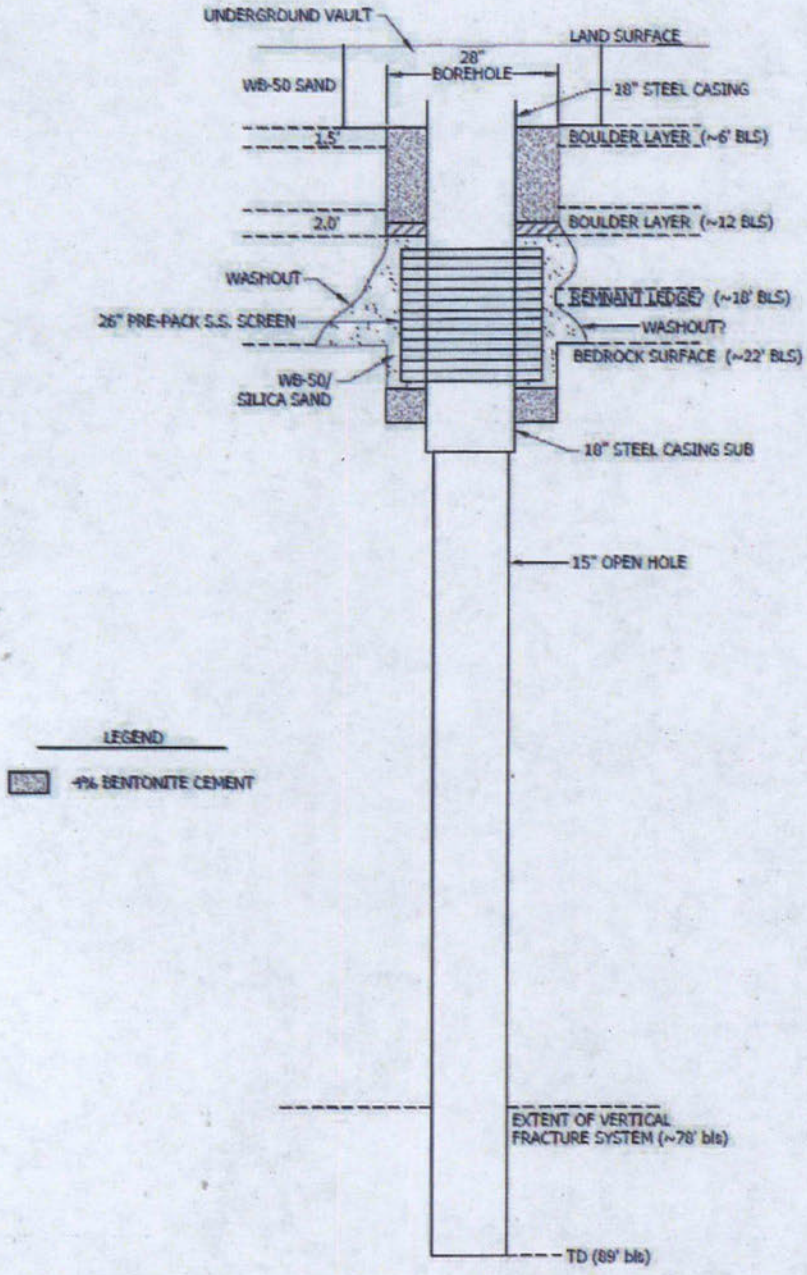
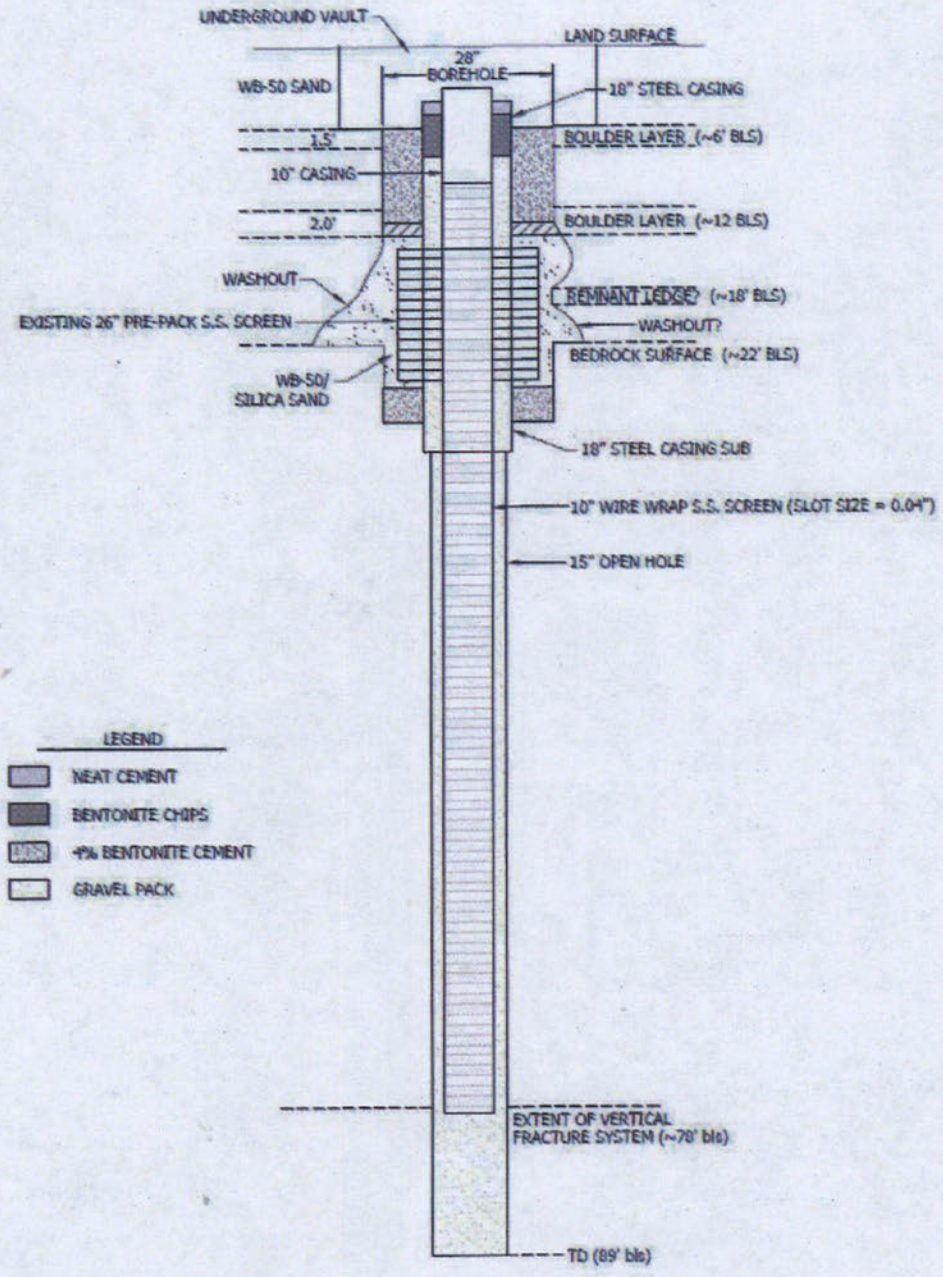


Figure 3 – Schematic of Pump and Treat System

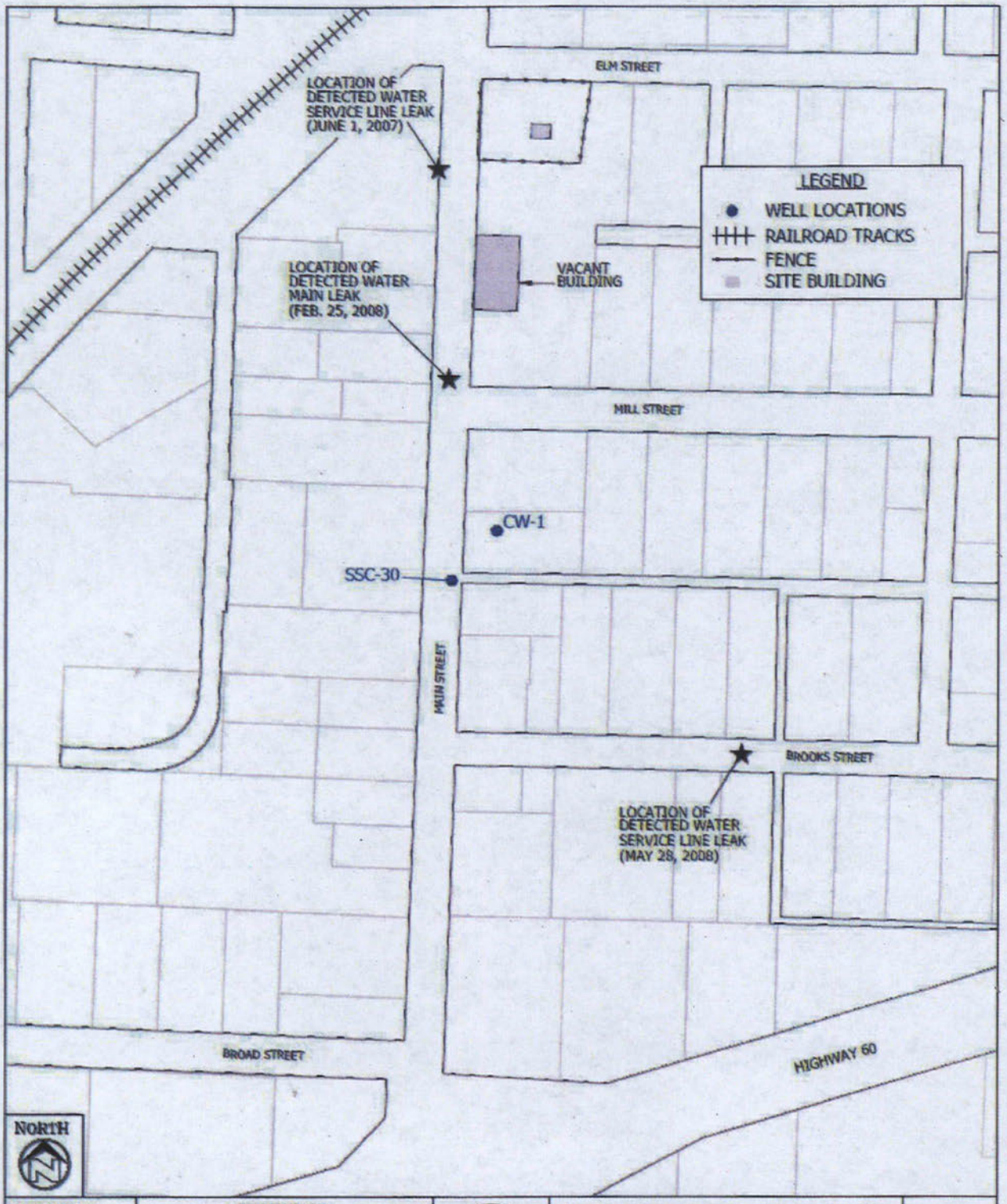

REPUBLIC, MO
LEGEND
UFSB WELL LOCATIONS
SBR WELL LOCATIONS
DBR WELL LOCATIONS
RAILROAD TRACKS
FENCE
SITE BUILDING
SSC-4B
MW-7
SSC-4A
MW-3
HW-N
MW-2
SSC-6C
SSC-9
ELM STREET
MW-1
SSC-6B
REM-2
REM-1
SSC-29
SSC-11
SSC-13
SSC-14
HW-S
MW-6
SSC-28
MW-S
MILL STREET
SSC-1A
MW-4
SSC-32
CW-1A
CW-1B
SSC-12
SSC-20
SSC-3A
SSC-23
SSC-24
SSC-3B
SSC-28
SSC-30
SSC-21
SSC-15
SSC-16
BROOKS STREET
SSC-18
MAIN STREET
SSC-17
BROAD STREET
SSC-25
SSC-26
SSC-27
HIGHWAY 60
SSC-19
SSC-31
CAVE WELL
SHUYLER CREEK
NORTH
CHECKED BY: M. KENWORTHY
E.W.I. # 60185
DRAWN BY: MEK
SEPT. 30, 2011
SCALE IN FEET
0 125 250
APPROXIMATE
ENVIRONMENTAL WORKS
Springfield Office Location:
1455 E. Chestnut Expressway
Springfield, MO 65802
Phone: (417) 890-9000
SITE DETAIL MAP
SOLID STATE CIRCUITS, INC. SUPERFUND SITE
108 S. MAIN STREET
REPUBLIC, MISSOURI
FIGURE
4



CHECKED BY: A. MOORE E.W.I. # 60185 DRAWN BY: MEK SEPT. 29, 2011	VERTICAL SCALE (FT) 0 6 12 24 APPROXIMATE	ENVIRONMENTAL WORKS INC. 1455 E. Chestnut Expressway Springfield, MO 65802	SSC-30 CONSTRUCTION DIAGRAM - ORIGINAL (1993) SOLID STATE CIRCUITS, INC. SUPERFUND SITE 108 S. MAIN STREET REPUBLIC, MISSOURI	FIGURE 5

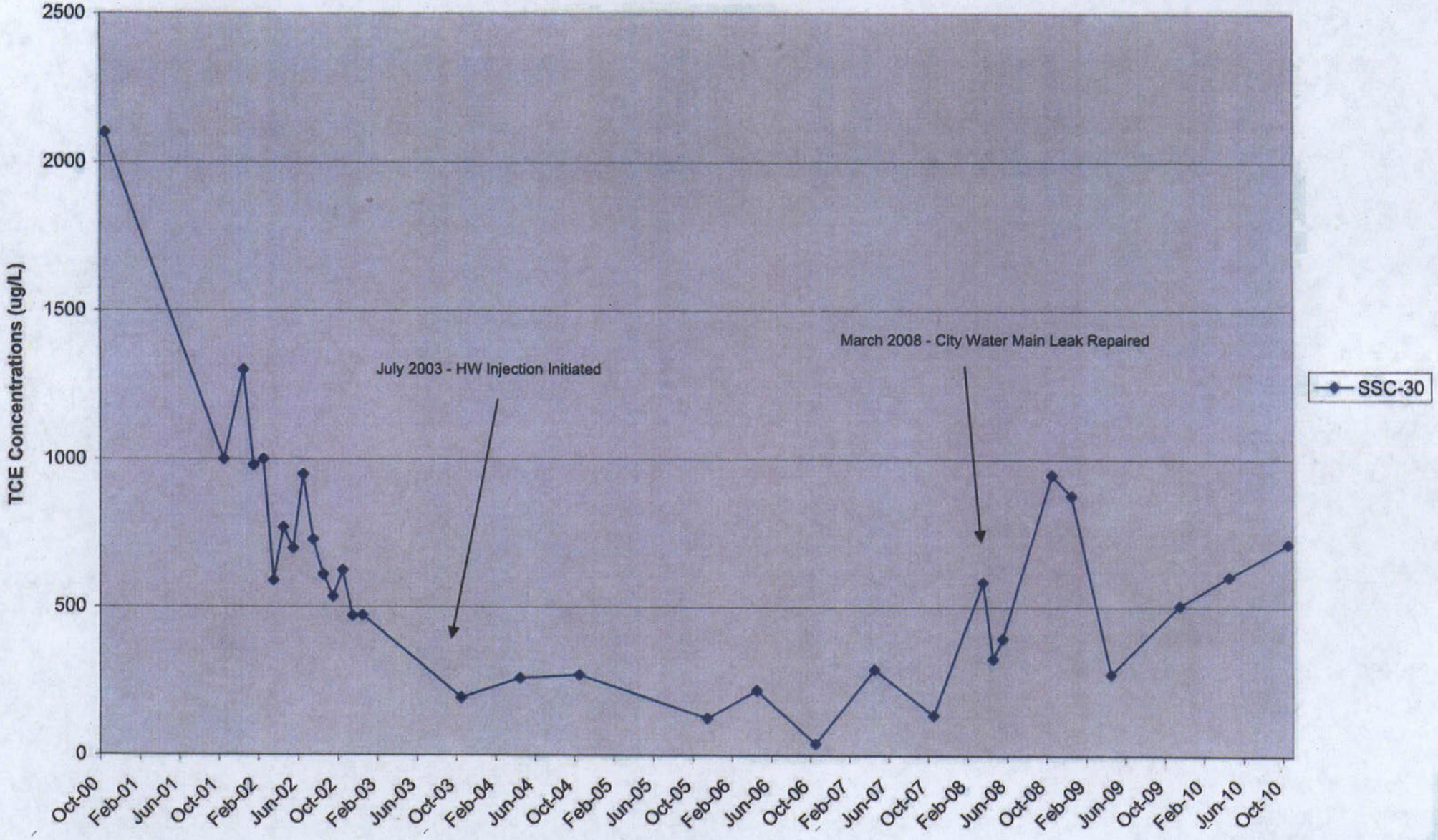


CHECKED BY: A. MOORE E.W.I. # 60185 DRAWN BY: MEK JAN. 5, 2009	VERTICAL SCALE (FT) 0 6 12 24 APPROXIMATE	ENVIRONMENTAL WORKS INC. 1455 E. Chestnut Expressway Springfield, MO 65802	SSC-30 CONSTRUCTION DIAGRAM (CURRENT) SOLID STATE CIRCUITS, INC. SUPERFUND SITE 108 S. MAIN STREET REPUBLIC, MISSOURI	FIGURE 6



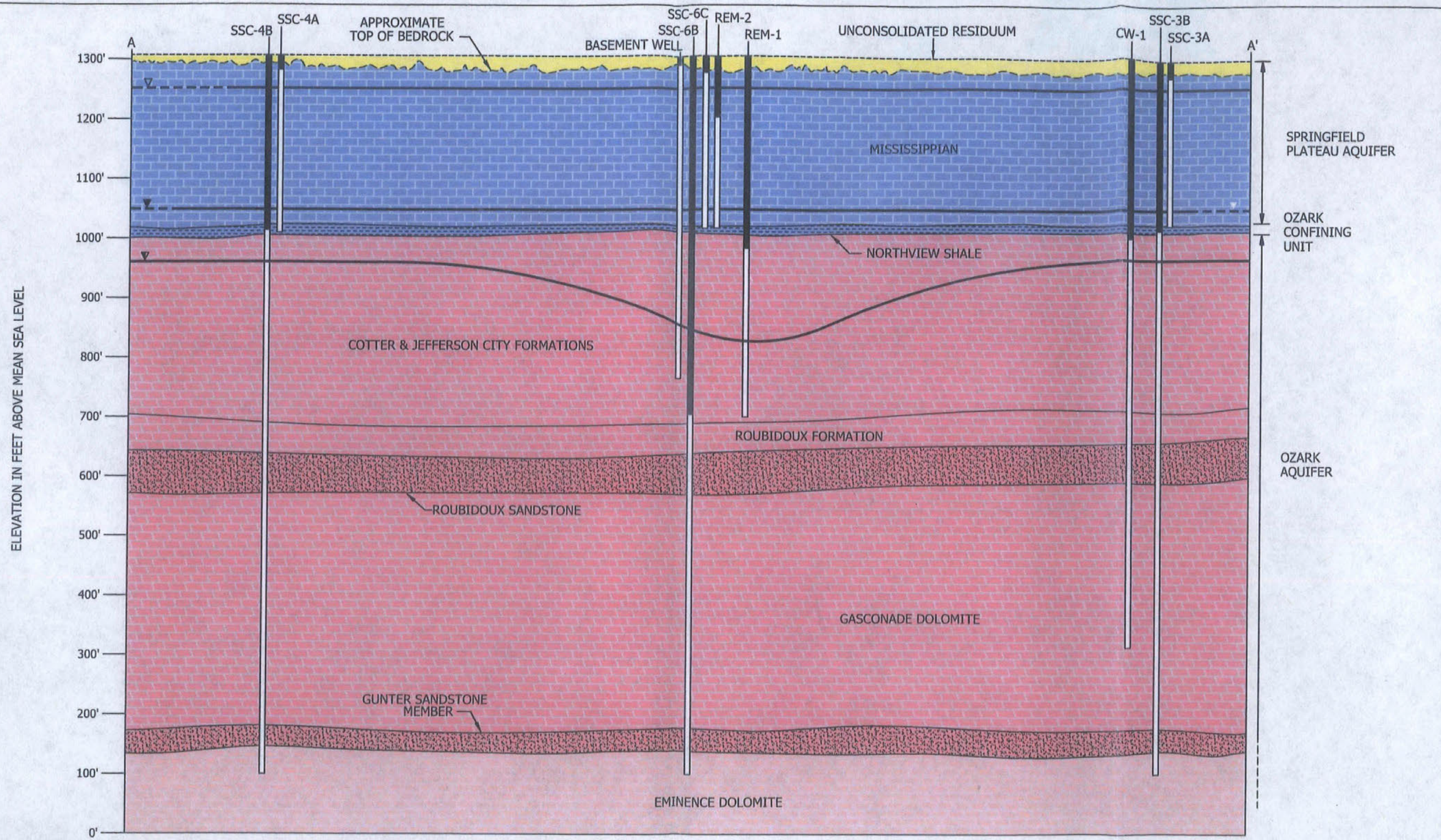
CHECKED BY: A. MOORE E.W.I.# 60185 DRAWN BY: NEK SEPT. 8, 2011	SCALE IN FEET 0 100 200 400 APPROXIMATE	ENVIRONMENTAL WORKS INC. 1455 E. Chestnut Expressway Springfield, MO 65802	WATER MAIN LEAK LOCATION SOLID STATE CIRCUITS, INC. SUPERFUND SITE 108 S. MAIN STREET REPUBLIC, MISSOURI	FIGURE 7

Figure 4-7
SSC-30 TCE Concentration Trend
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011



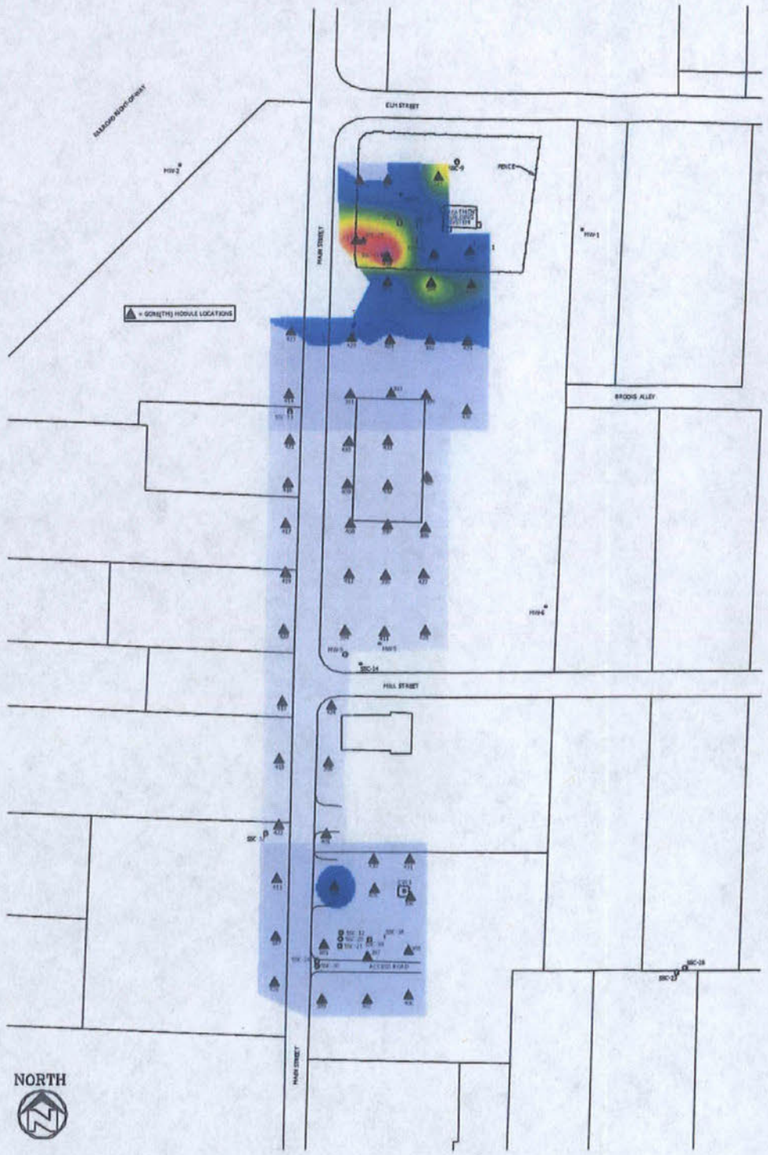
Enviornmental Works, Inc.
MRAC 60185

Figure 8



CHECKED BY: M. KENWORTHY	ENVIRONMENTAL WORKS	CROSS-SECTION INCLUDING CW-1	FIGURE
E.W.I. # 60185 DRAWN BY: MEK AUG. 12, 2011	Springfield Office Location: 1455 E. Chestnut Expressway Springfield, MO 65802 Phone: (417) 890-9500	SOLID STATE CIRCUITS, INC. SUPERFUND SITE 108 S. MAIN STREET REPUBLIC, MISSOURI	1-4

Figure 9



0.233
0.199
0.171
0.146
0.125
0.107
0.092
0.079
0.067
0.058
0.049
0.042
0.036
0.031
0.027
0.023
0.019
0.017
0.014
0.012
0.010

TCE [µg]

Scale 1:1680

100 0 100 200 300

feet

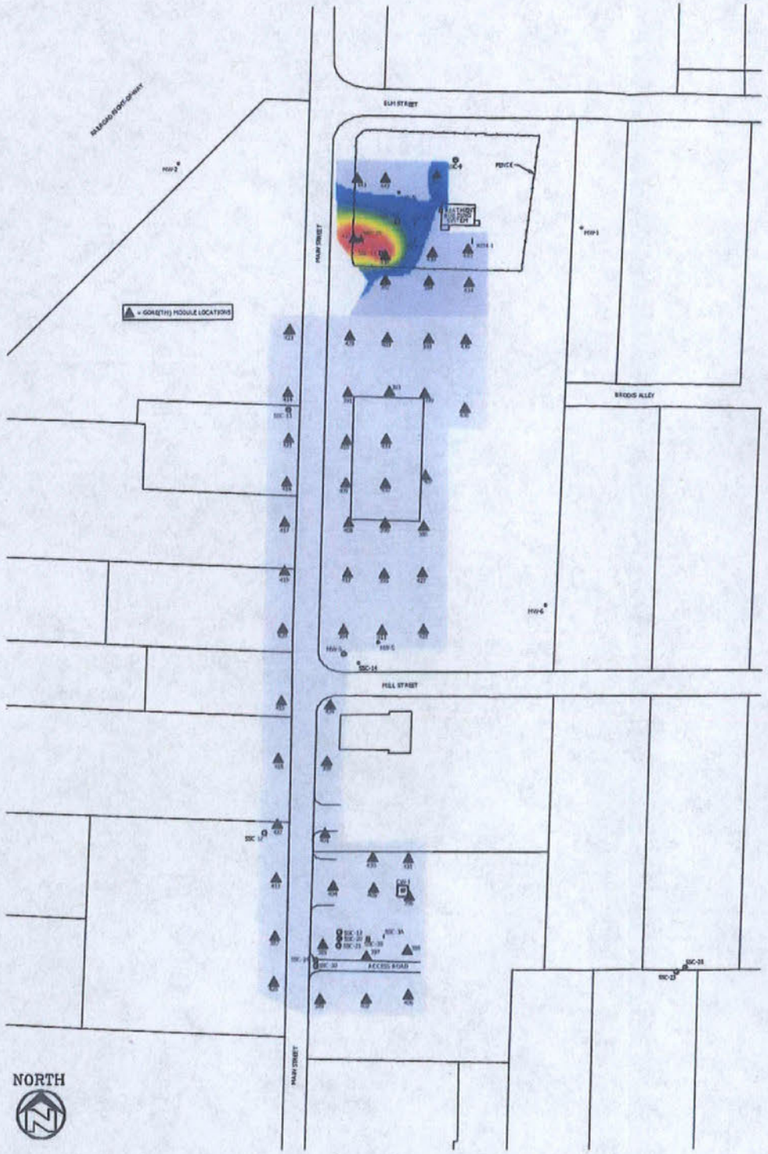
Figure 10

GORE ™ Surveys for Environmental Site Assessment

W.L. GORE & ASSOCIATES, INC.
100 CHESAPEAKE BOULEVARD
ELKTON, MD, USA 21921
USA
(410) 392-7600

Environmental Works, Inc., Springfield, MO
Former Solid State Circuits, Republic, MO
Trichloroethene

DATE DRAWN: 31 July 2007	DRAWN BY: JW	ORIG. CAD: 60185P...DWG	SITE CODE: DUD
Figure 7-2	REV.#:	PROJECT NUMBER: 13212941	



0.470
0.401
0.343
0.293
0.250
0.213
0.182
0.156
0.133
0.114
0.097
0.083
0.071
0.060
0.052
0.044
0.038
0.032
0.027
0.023
0.020

1,1,1-TCA
[µg]

Scale 1:1680

100 0 100 200 300
feet

Figure 11

GORE ™ Surveys for Environmental Site Assessment

GORE
Creative Technologies Worldwide

W.L. GORE & ASSOCIATES, INC.
100 CHESAPEAKE BOULEVARD
ELKTON, MD, USA 21921
USA
(410) 392-7600

Environmental Works, Inc., Springfield, MO
Former Solid State Circuits, Republic, MO
1,1,1-Trichloroethane

DATE DRAWN: 31 July 2007	DRAWN BY: JW	ORIG. CAD: 60185P...DWG	SITE CODE: DUD
Figure 7-3	REV. #:	PROJECT NUMBER: 13212941	

Attachment B

MISSOURI STATE FIRE MARSHAL'S REPORT

MISSOURI DEPARTMENT OF PUBLIC SAFETY

DIVISION OF FIRE SAFETY

INCIDENT REPORT

Case Number: 12/8/2011 0462

CASE NAME MRAC - Solid States Circuits **County:** Greene

Location Republic **Address:** 108 South Main Street

OCCURENCE 12/8/2011 **Time:** 4:34 AM **Day:** Thursday **Weather** Clear, Cold

Date Requested 12/8/2011 **Time Requested** 6:00 AM **Cause/Type** Accidental

STATUS
- ☐ criminal_info
- ☑ closed
- ☐ confidential
- ☐ warrant_app
- ☑ non_criminal
- ☑ unclassified

UTILITIES IN SERVICE
- ☑ electricity
- ☐ lp_gas
- ☐ fuel_oil
- ☑ natural_gas
- ☐ wood
- ☐ none

Arrests: ☐ **Offense:** **Other:**

CONSTRUCTION
- **Construction Type:** Non-Combustible **Levels:** 1
- **Occupancy Type:** Other
- **Occupied** ☑ **Vacant** ☐

FATALITIES
- **No. Civilian Fatalities:** 0
- **No. Firefighter Fatalities:** 0

INJURIES
- **No. Civilian Injuries:** 0
- **No. Firefighter Injuries:** 0

Smoke Detectors Present No

COPIES

☐ PA_copy ☐ Sheriff_copy ☐ PD_copy ☐ FD_copy **Other_copy:** Mo Dept. of Natural Resour

ASSISTING INVESTIGATOR(S)

Investigator 2:

Investigator 3:

Investigator_4:

Investigator 5:

DFS Investigator

Sweet, Randy - DSN 1475

DFS Reviewing Supervisor

Kleyh, Dennis - DSN 1466

MISSOURI DEPARTMENT OF PUBLIC SAFETY

DIVISION OF FIRE SAFETY

INCIDENT REPORT
Owner Information

Case Number: 12/8/2011 0462

CASE NAME: MRAC - Solid States Circuits Location Republic County: Greene

Owner and Occupant Are Same ☑

OWNER First: Last: Address: 108 South Main Street

City: Republic State: MO Zip: Phone: (417) 890-9500 Race: Sex:

Age: 0 POB: Marital Status:

Occupation: Employer: Phone:

DBA: MRAC-Solid States Circuits

INSURANCE

Amt on Structure: $0.00 Company: Agency:

MISSOURI DEPARTMENT OF PUBLIC SAFETY
DIVISION OF FIRE SAFETY

INCIDENT REPORT
Owner Information

Case Number: 12/8/2011 0462

CASE NAME MRAC - Solid States Circuits **Location** Republic **County:** Greene

Owner and Occupant Are Same

OWNER **First:** **Last:** **Address:**

City: **State:** **Zip:** **Phone:** **Race:** **Sex:**

Age: 0 **POB:** **Marital Status:**

Occupation: **Employer:** **Phone:**

DBA:

INSURANCE

Amt on Structure: $0.00 **Company:** **Agency:**

MISSOURI DEPARTMENT OF PUBLIC SAFETY
DIVISION OF FIRE SAFETY

INCIDENT REPORT
Person Information

Case Number: 12/8/2011 0462

CASE NAME: MRAC - Solid States Circuits Location: Springfield County: Greene

PERSON First: Jason Last: Smith Address: 1455 E Chestnut

City: Springfield State: MO Zip: Phone: (417) 689-1940 Race: Sex:

Age: POB: Marital Status:

Relationship to Incident: Site Manager/Environmental Works

MISSOURI DIVISION OF FIRE SAFETY

CASE ACTIVITY REPORT

Case Number:	**12-08-11-0462**	*Date:*	**12-08-11**
Case Name:	**MRAC – Solid States Circuits**		
Case Activity:	**Incident Report**	*Date of Activity:*	**12-08-11**

I was contacted at about 6:00 a.m., 12-08-11, by the Republic 911 Center and was advised the Republic Fire Department was requesting assistance with an investigation.

I arrived at about 6:20 a.m., 12-08-11, and was met by members of the fire department, who had secured the scene.

Due to a large amount of contaminated water being retained in the bottom of the structure, an investigation could not be completed at this time.

At about 3:00 p.m., 12-08-11, I arrived back at the structure and was advised by members of the company controlling the structure it was safe to enter. A Consent to Search form was signed and is attached.

Copies to:	
Investigator: **Randy Sweet, 1475**	*Reviewing Supervisor:* **Dennis Kleyh, 1466**

MISSOURI DIVISION OF FIRE SAFETY

CASE ACTIVITY REPORT

Case Number:	**12-08-11-0462**	*Date:*	**12-08-11**
Case Name:	**MRAC – Solid States Circuits**		
Case Activity:	**Fire Scene Investigation**	*Date of Activity:*	**12-08-11**

This fire loss occurred in a one-level, noncombustible structure, with electricity and natural gas in service.

Exterior Examination

Exterior examination showed the roof collapsed and consumed.

The cement block exterior walls showed heavy heat damage below the roofline.

Interior Examination

Interior examination showed extensive fire damage throughout the structure. The contents of this building consisted of two large "scrubbers" to clean trichloroethylene out of the ground water. The process consists of a water pump brining the water up from below the ground, to a pump, through the "scrubber" cleaning the trichloroethylene from the water sending it into the air and then sending the water to the waste water treatment plant.

The electric motor running a blower on the south "scrubber" was found seized. The heaviest amount of fire and heat damage was found to this unit. The fiberglass filtering system was found melted to the floor. The metal framing showed extensive heat damage.

The electric motor was found seized. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire.

No other area of fire origin was found inside the structure.

Conclusion

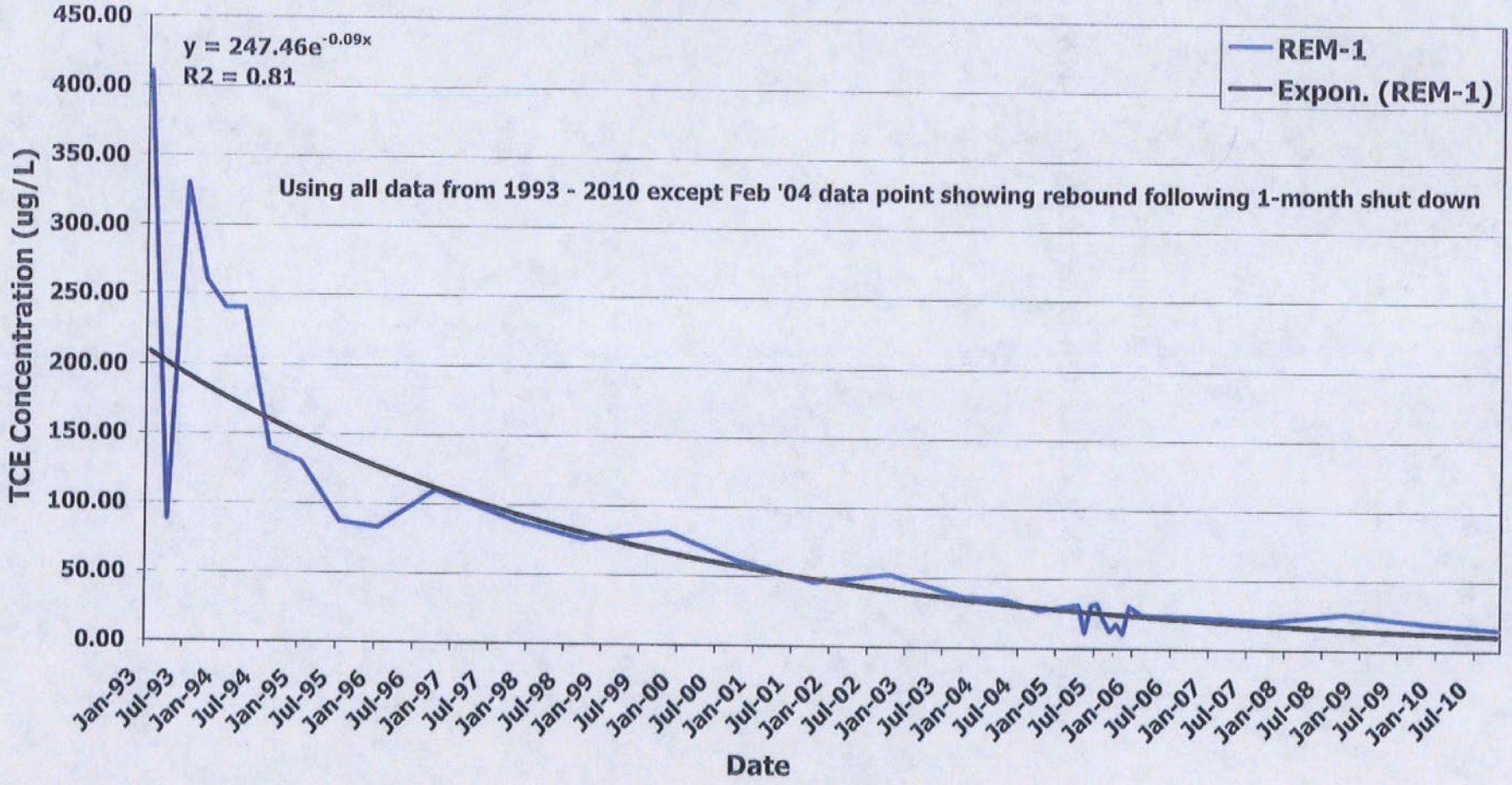
The electric motor was found seized on the south unit. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire. The cause of this fire is being listed as accidental.

Copies to:	
Investigator: **Randy Sweet, 1475**	*Reviewing Supervisor:* **Dennis Kleyh, 1466**

Attachment C

SUMMARY OF TCE TREND PLOTS

FIGURE 2-6
TCE Concentration Trend in DBR Well REM-1 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011



Environmental Works, Inc.
MRAC 60185

FIGURE 2-12
TCE Concentration Trend in SBR Well REM-2 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011

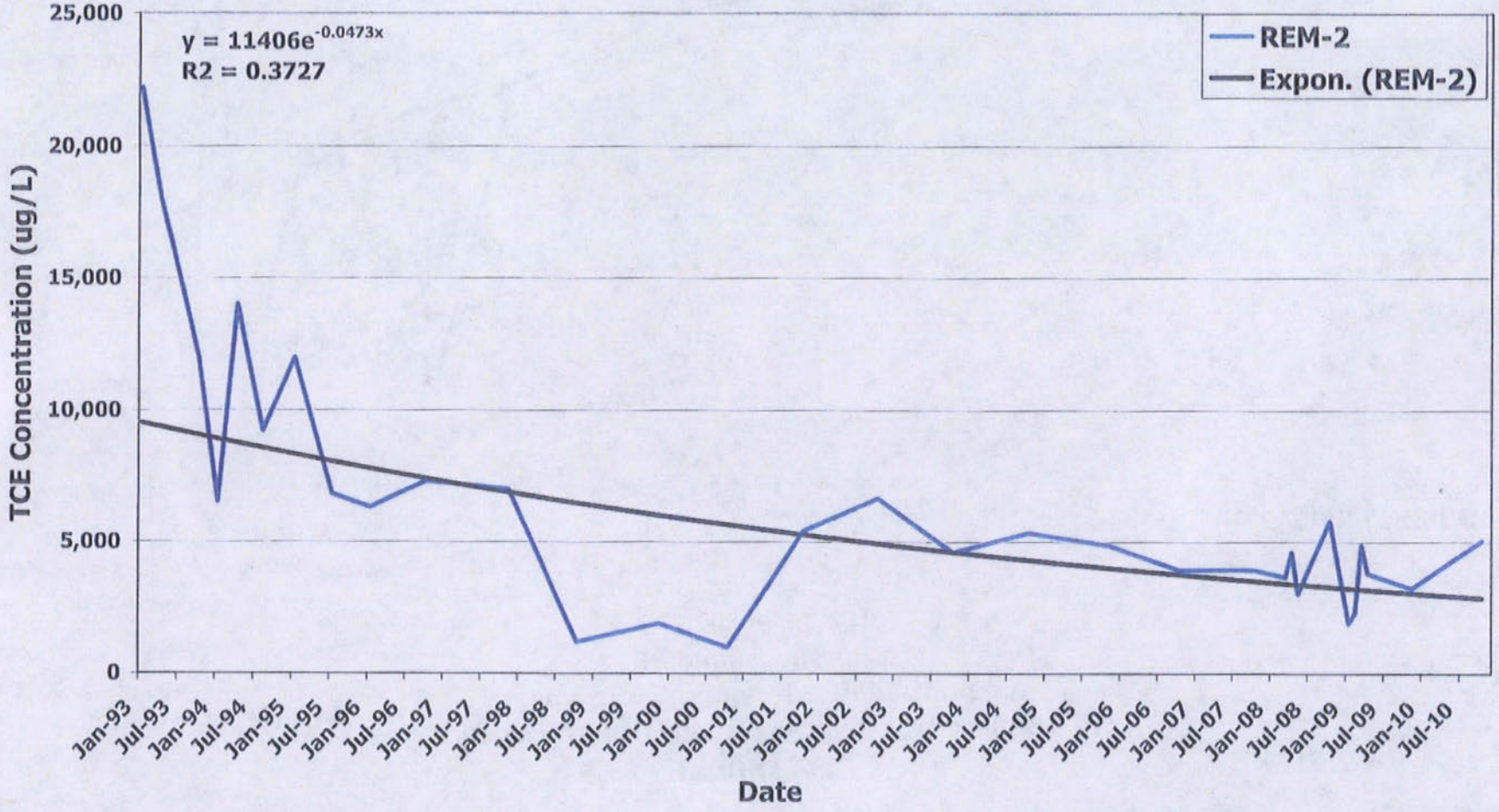


FIGURE 2-13
TCE Concentration Trend in SBR Well SSC-6C (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2010

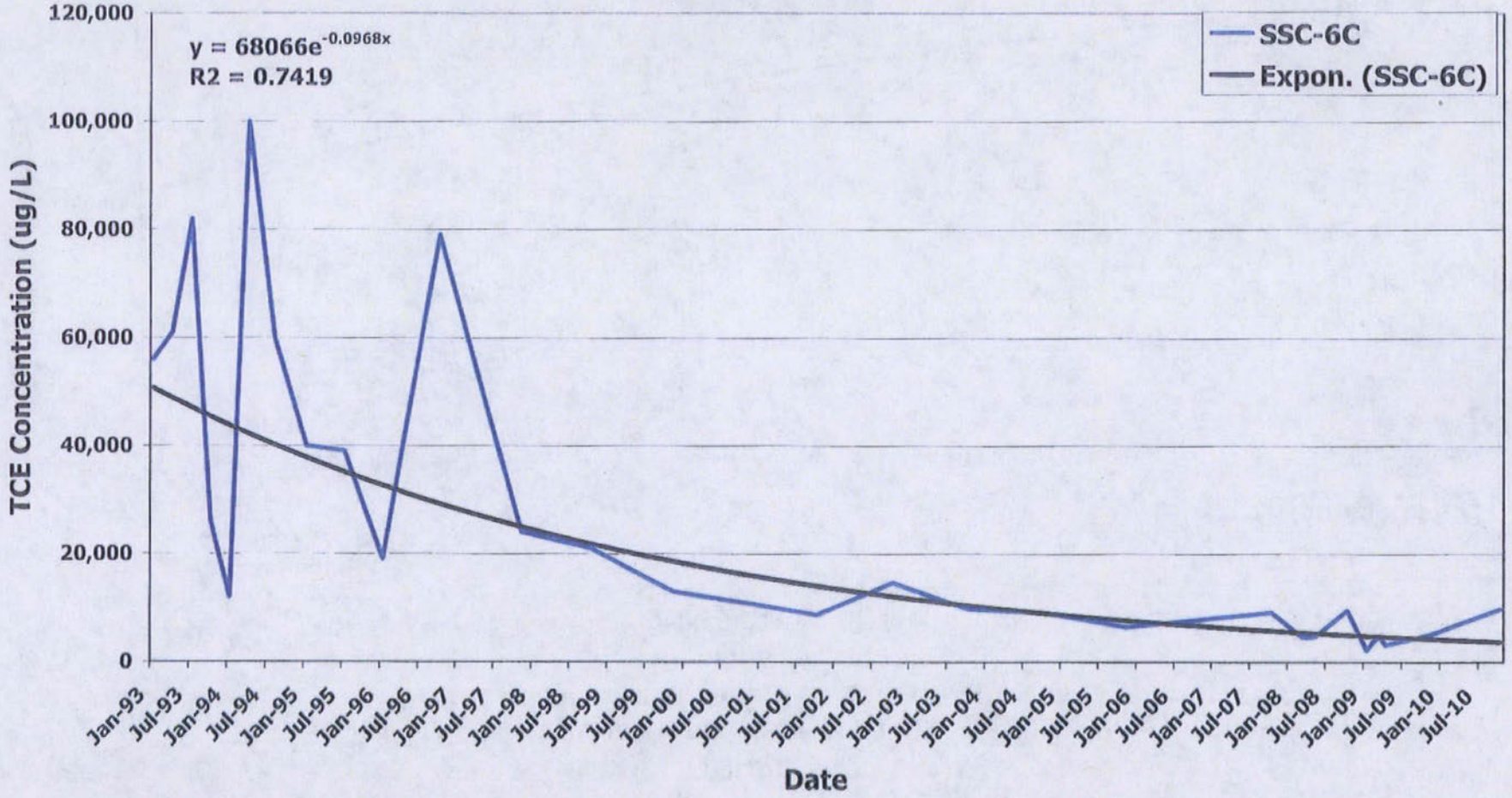


FIGURE 2-14
TCE Concentration Trend in UFSB Well SSC-3A (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011

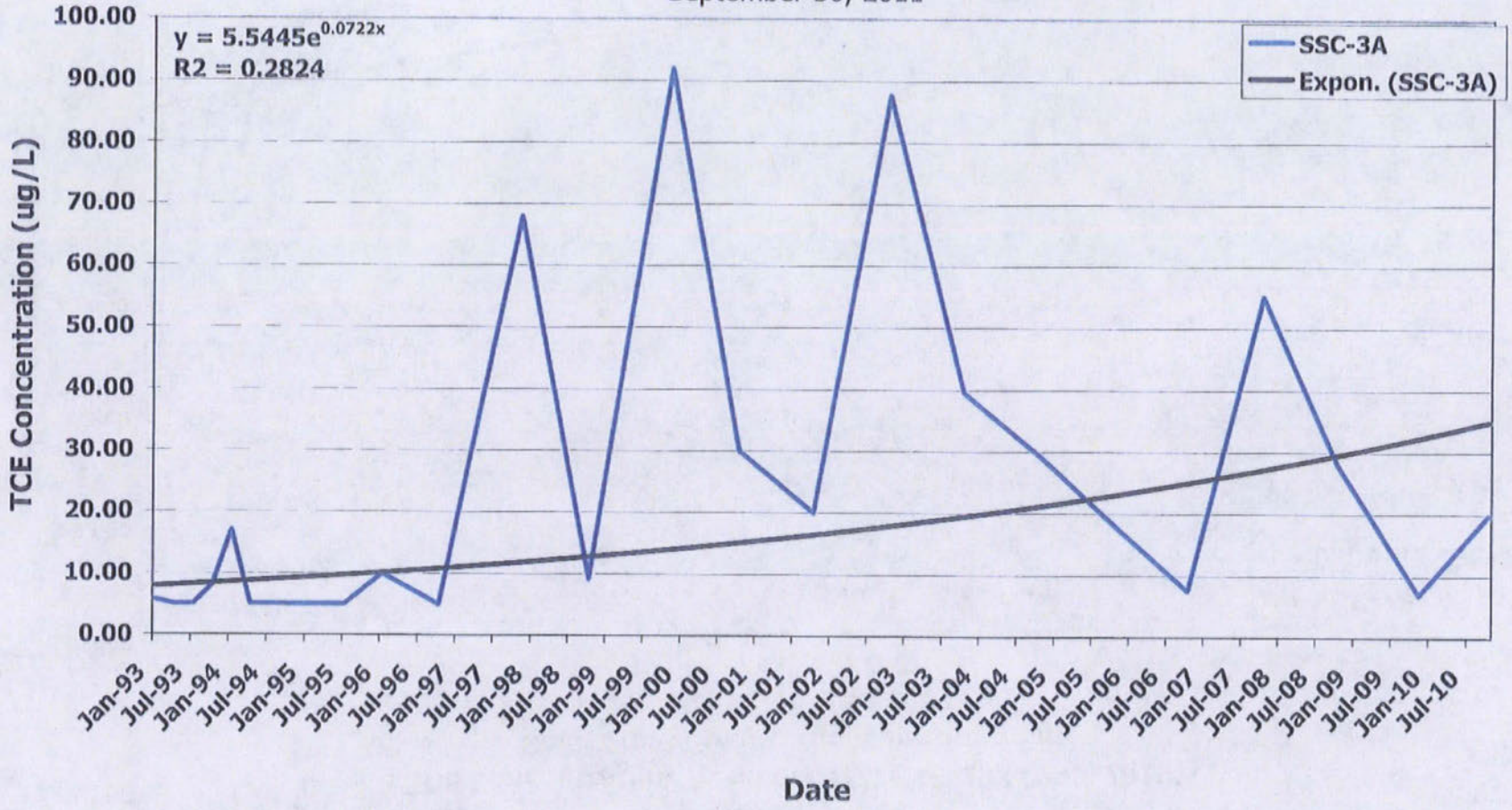


FIGURE 2-20
TCE Concentration Trend in UFSB SSC-29 (1993-2010)
Solid State Circuit, Inc. Superfund Site
Republic, Missouri
September 30, 2011

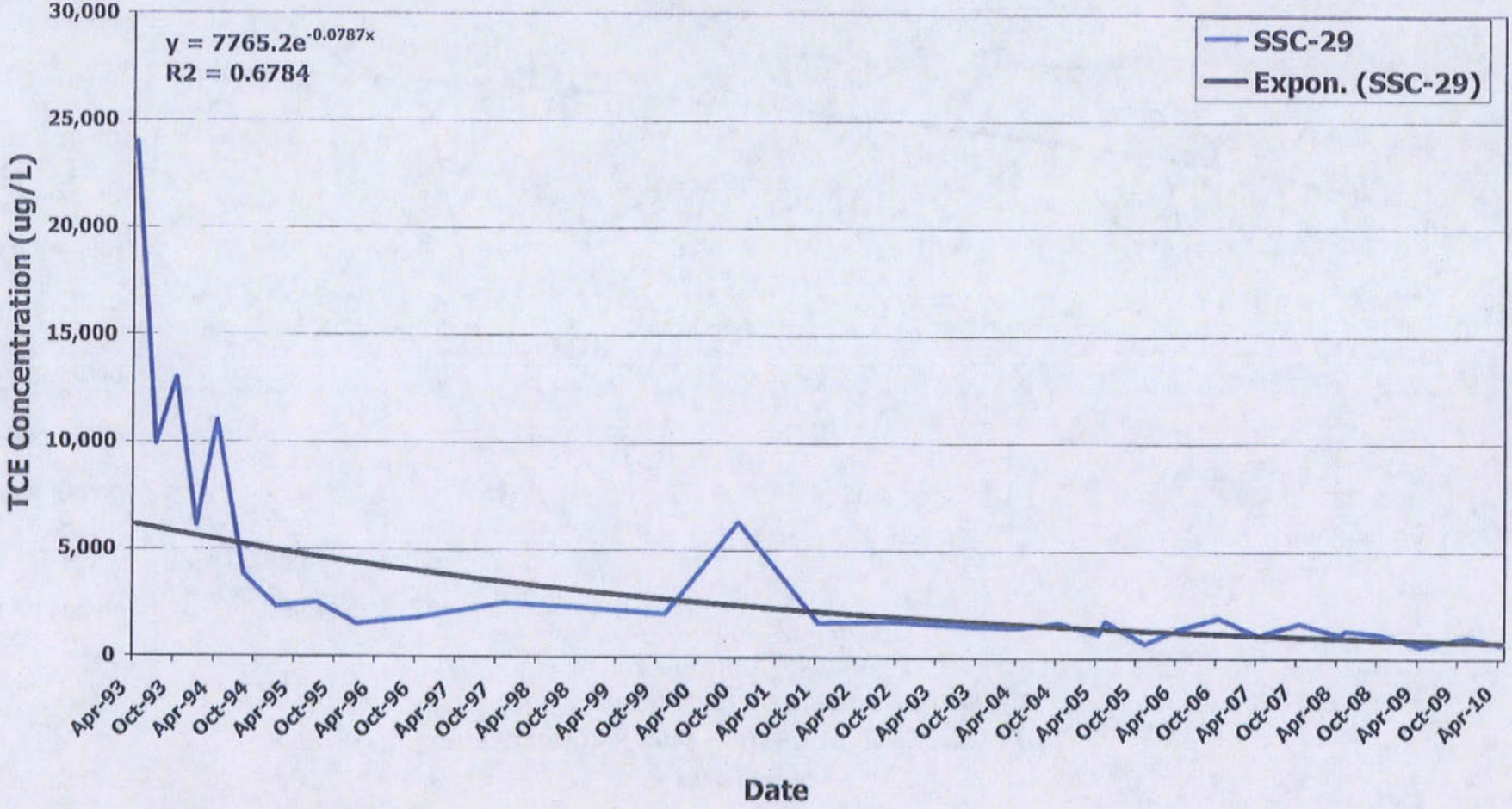


FIGURE 2-21
TCE Concentration Trend in UFSB Well SSC-11 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011

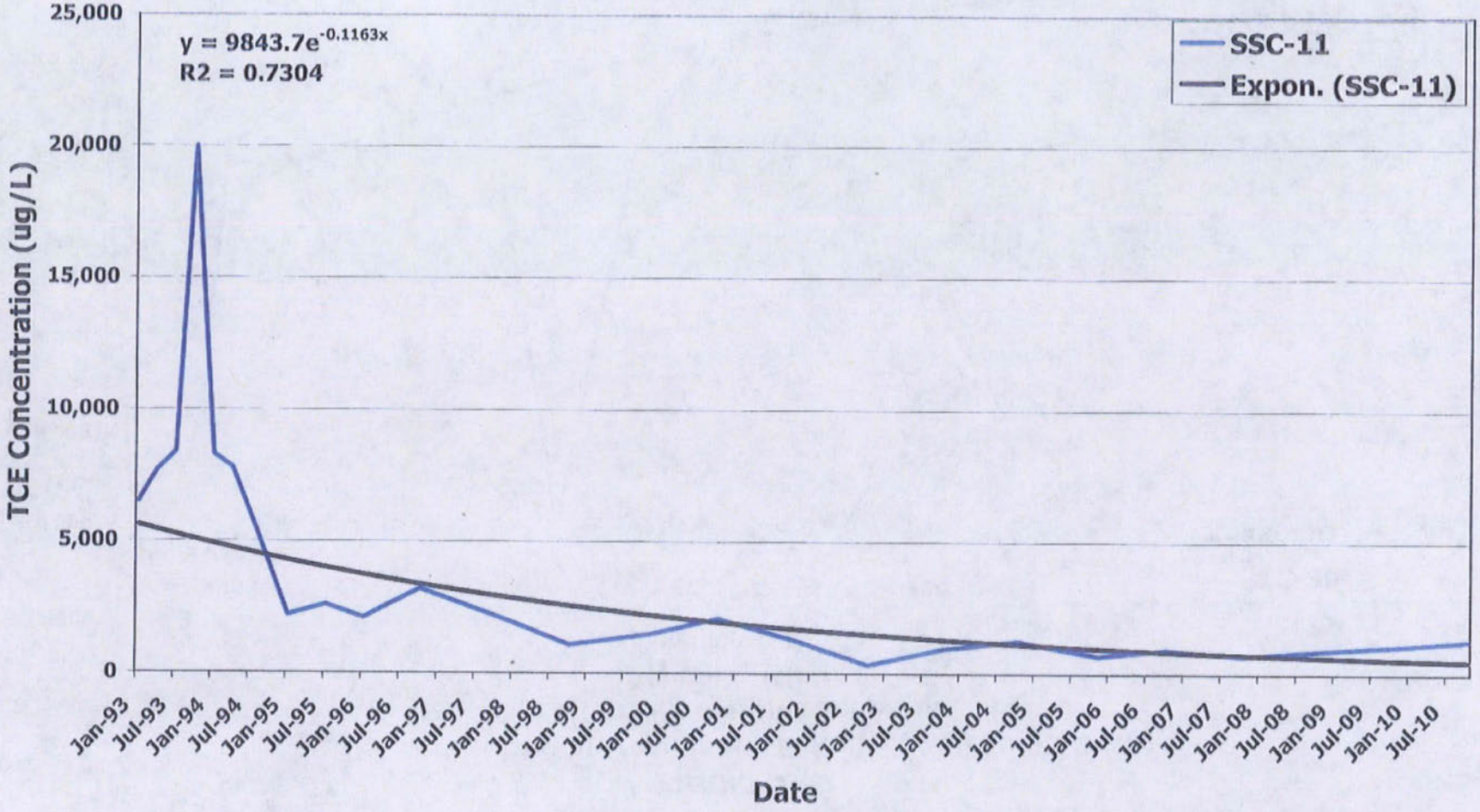


FIGURE 2-22
TCE Concentration Trend in UFSB Well SSC-30 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011

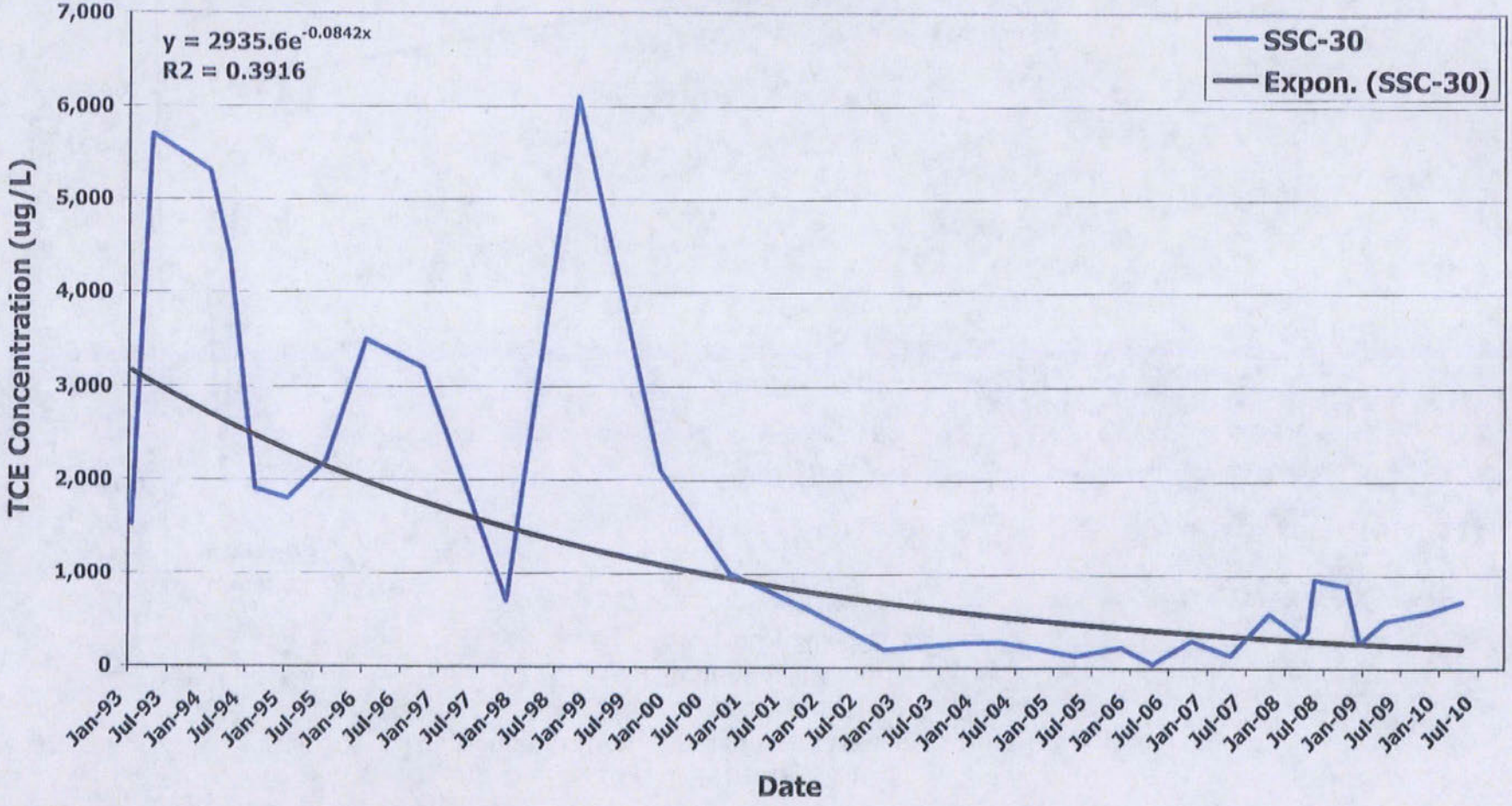


FIGURE 2-23
TCE Concentration Trend in UFSB Well SSC-20 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011

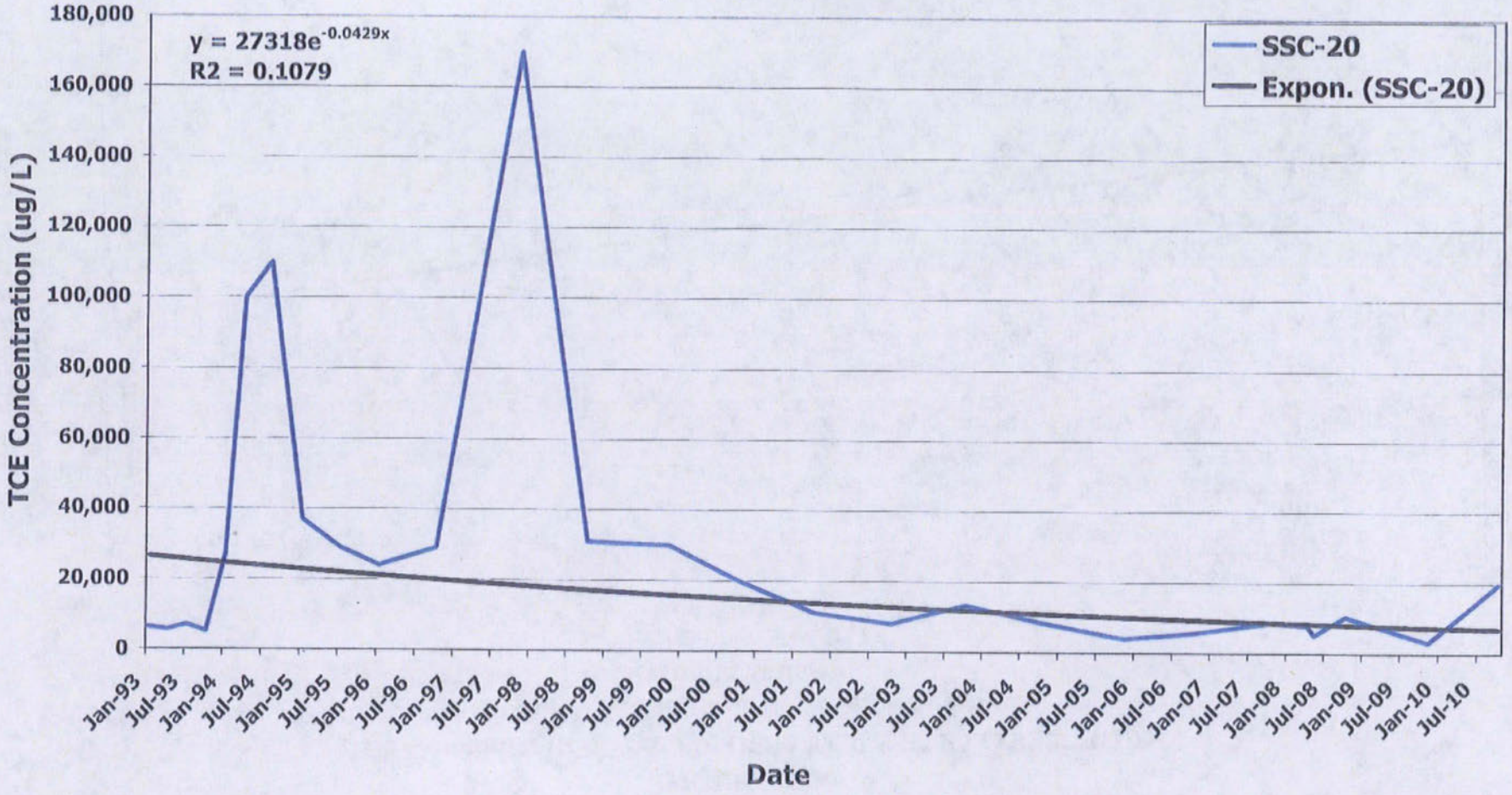
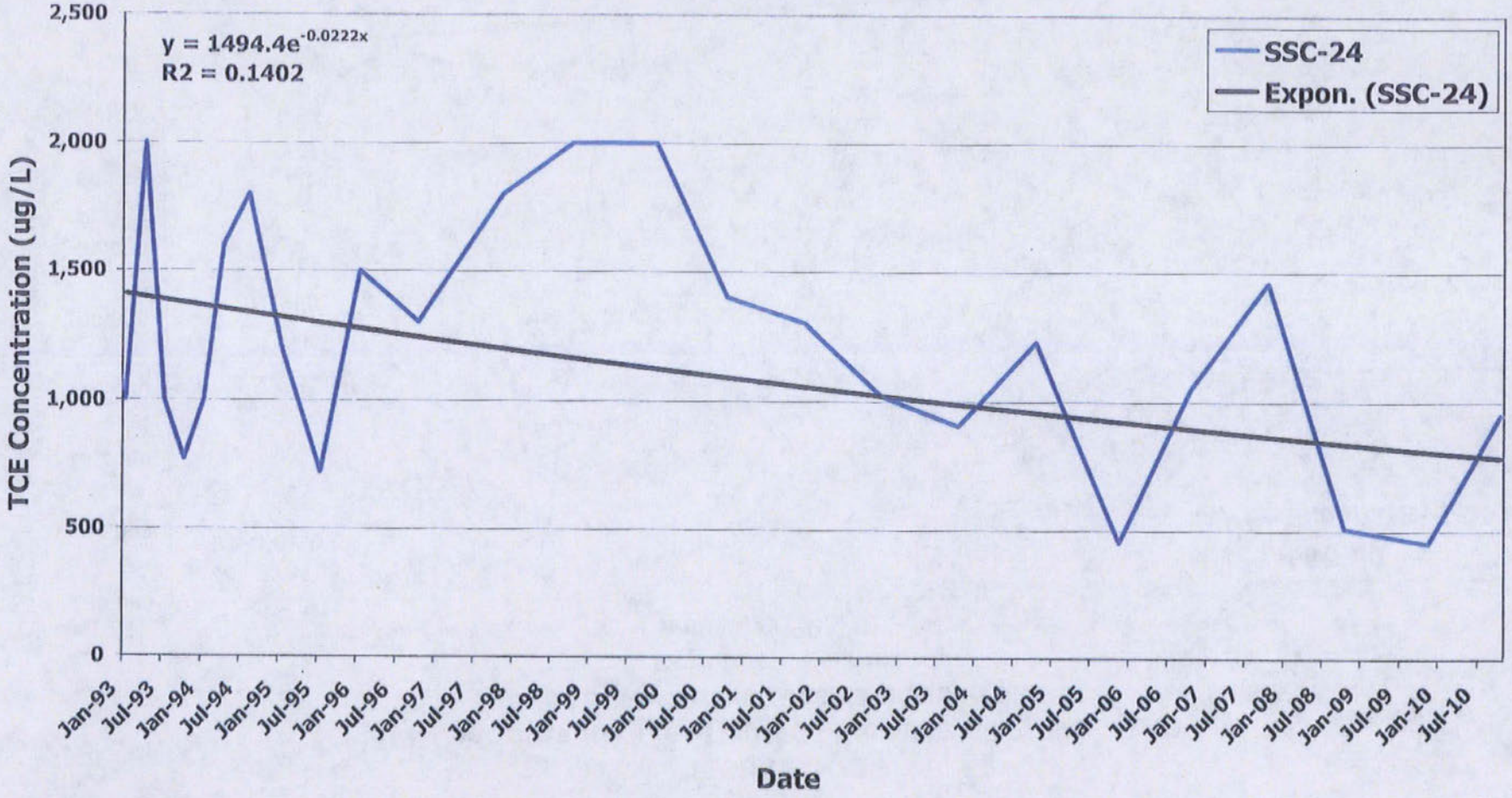


FIGURE 2-24
TCE Concentration Trend in UFSB Well SSC-24 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011



Environmental Works, Inc.
MRAC 60185

FIGURE 2-25
TCE Concentration Trend in UFSB Well SSC-32 (1997-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011

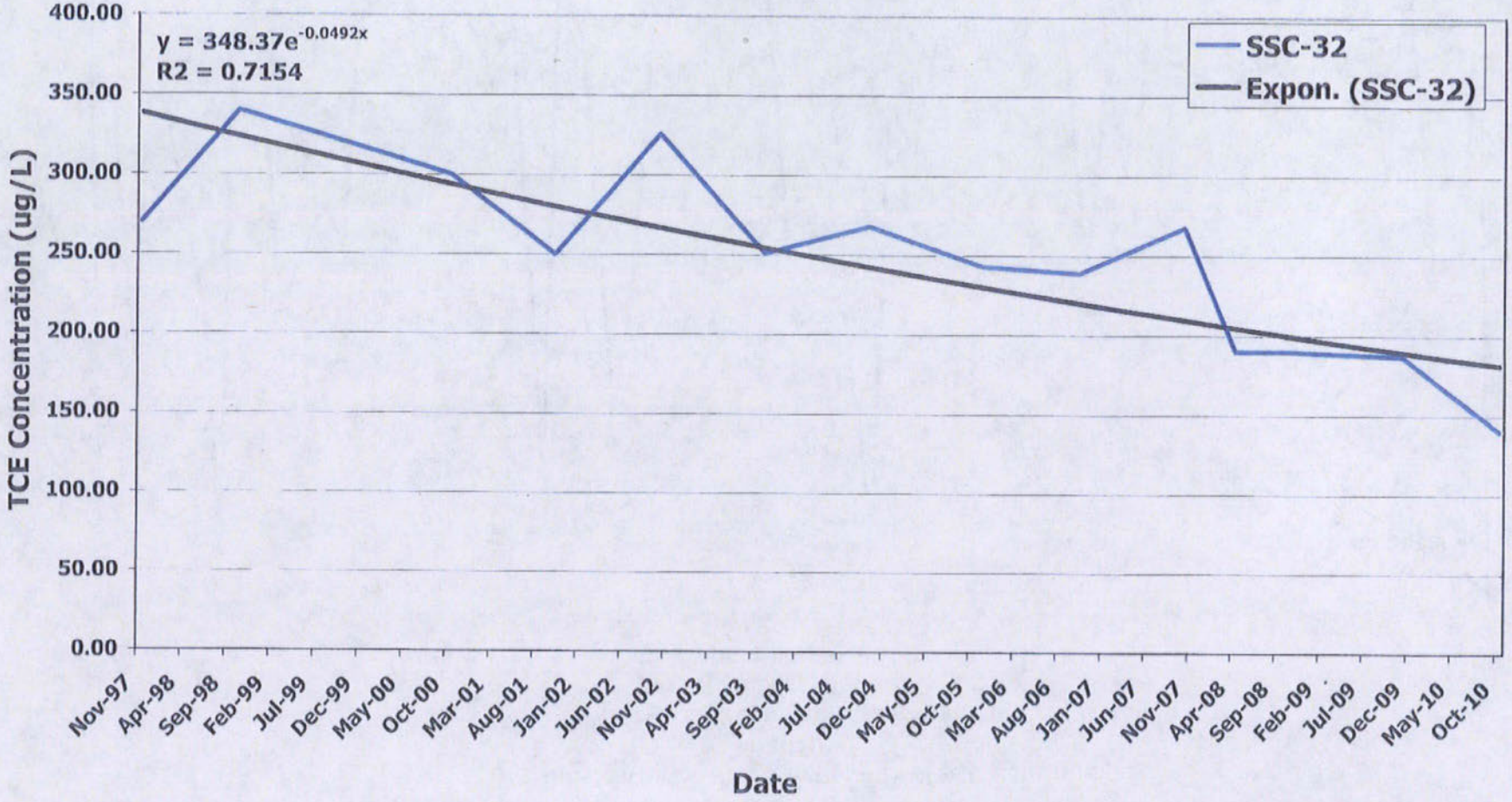
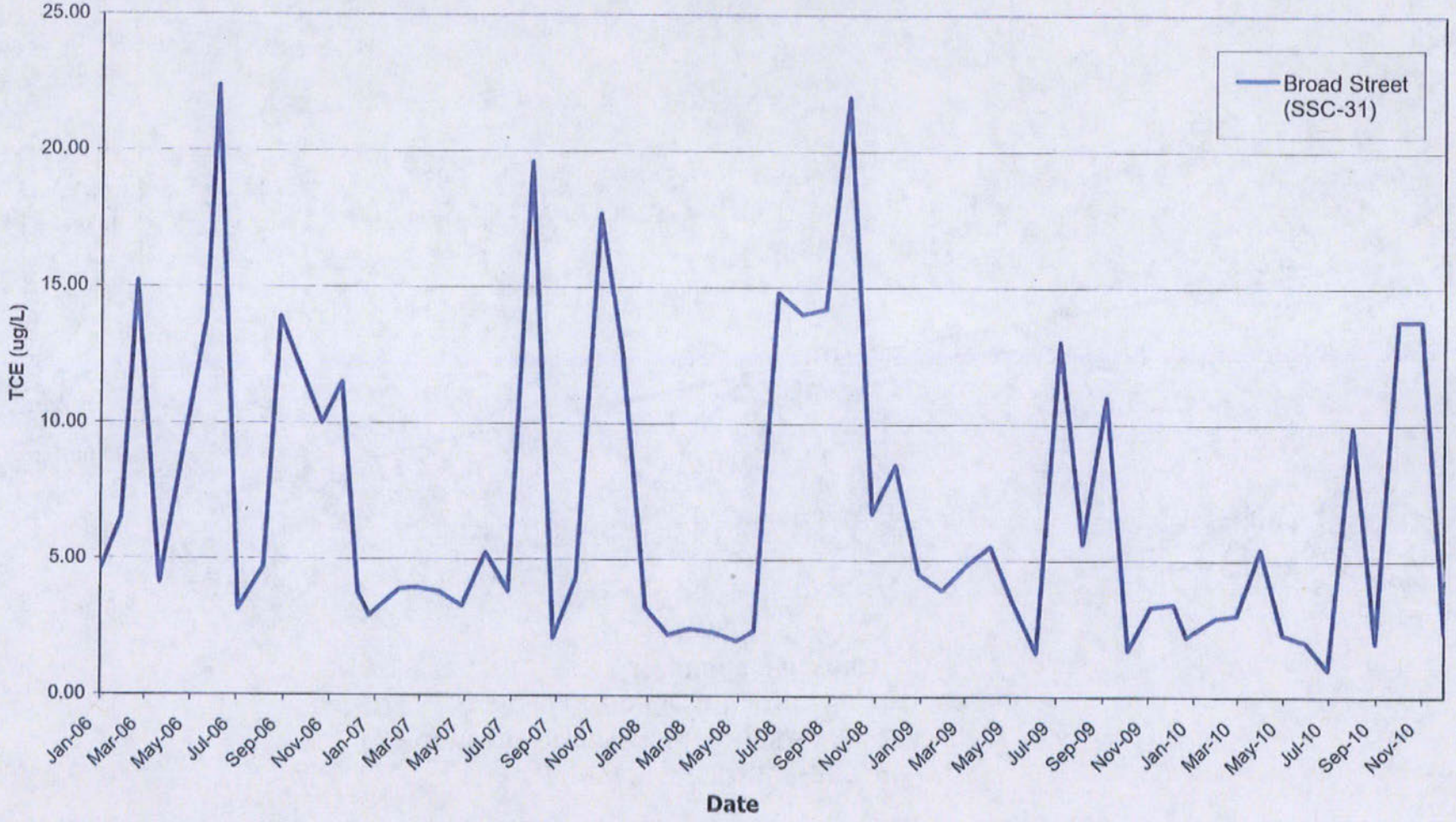
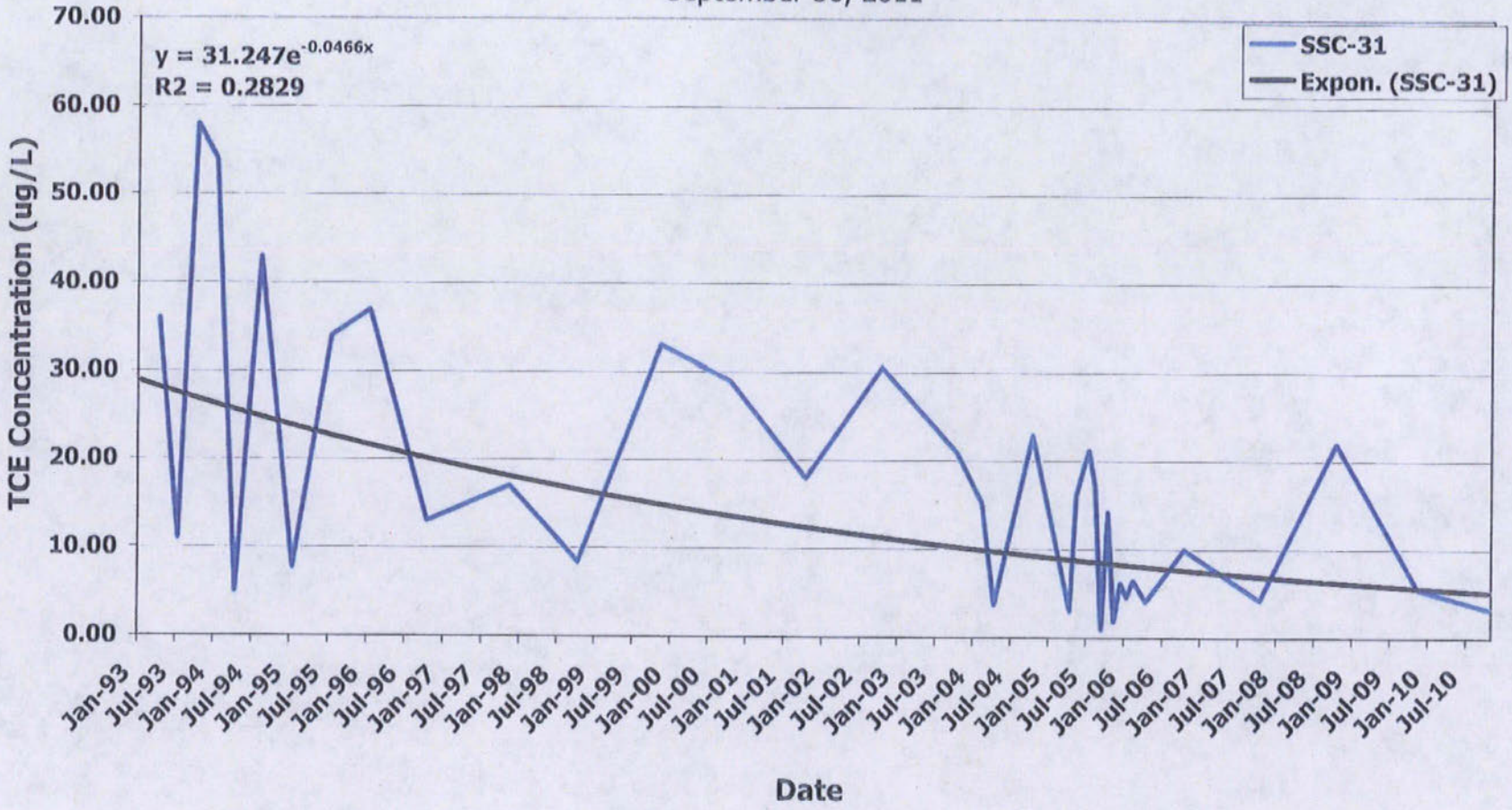


FIGURE 2-26
TCE Concentration Trend in UFSB Well SSC-31 (2006-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011



Environmental Works, Inc.
MRAC 60185

FIGURE 2-27
TCE Concentration Trend in UFSB Well SSC-31 (1993-2010)
Solid State Circuits, Inc. Superfund Site
Republic, Missouri
September 30, 2011



Attachment D

SITE PHOTOGRAPHS

PRE-FIRE SITE PHOTOGRAPHS

Photograph 1
Solid State Circuits Site, Republic, MO
Taken on 04/06/2011, Candice McGhee, DEQ, HWP, SF
Photo of Roberts Spring and beginning of Unnamed Tributary. Facing North.

Photograph 2
Solid State Circuits Site, Republic, MO
Taken on 04/06/2011, Candice McGhee, DEQ, HWP, SF
Photo of Unnamed Tributary leaving Roberts Spring. Facing North.

Photograph 3
Solid State Circuits Site, Republic, MO
Taken on 04/06/2011, Candice McGhee, DEQ, HWP, SF
Photo of SSC site, south of Air Stripper bldg. REM-1 well (foreground).
1 of 3. Facing West, towards Main Street

Photograph 4
Solid State Circuits Site, Republic, MO
Taken on 04/06/2011, Candice McGhee, DEQ, HWP, SF
Photo of SSC site, north of Air Stripper bldg. 2 of 3.
Facing West, towards Main Street.

Photograph 5
Solid State Circuits Site, Republic, MO
Taken on 04/06/2011, Candice McGhee, DEQ, HWP, SF
Photo of SSC site, north of Air Stripper bldg. with SSC-09 well. 3 of 3.
Facing Northwest, towards intersection of Main Street and Elm Street.

Photograph 6
Solid State Circuits Site Republic, MO
Photo Taken 04/20/2001 Mark Rader, DEQ/SWRO
Close-up of treatment facility building behind closed gate and fence.
Photo taken facing Northwest, southern side of facility.

Photograph 7
Solid State Circuits Site Republic, MO
Photo Taken 04/20/2001 Mark Rader, DEQ/SWRO
Close-up of treatment facility building and outbuilding behind fence.
Photo taken facing Southwest, eastern side of facility.

Photograph 8
Solid State Circuits Site Republic, MO
Photo Taken 05/16/2000 Thomas Murray, DEQ/SWRO
View of back of treatment facility and close-up of fence with signage.
Photo taken facing East from west side of SSC site.

Photograph 9
Solid State Circuits Site Republic, MO
Photo Taken 05/16/2000 Thomas Murray, DEQ/SWRO
Close-up view of on-site wells and back treatment facility. Photo taken facing Northeast from southwest side of SSC site.

Photograph 10
Solid State Circuits Site Republic, MO
Photo Taken 05/16/2000 Thomas Murray, DEQ/SWRO
Close-up view of eastside of treatment facility and on-site well. Photo taken facing Southwest from north side of SSC site.

FOURTH FYR AND REGISTRY SITE PHOTOGRAPHS

Photograph 1
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012 Candice McGhee, DEQ/HWP/SPF

View of open entrance gate with remaining outbuilding and Baker tank. Photo taken Facing North into SSC site.

Photograph 2
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF
View of SSC site on gravel road along eastern fence line overlooking footprint of treatment building. Photo taken Facing West towards Main Street.

Photograph 3
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

View of monitoring well (MW-1) across the gravel road from SSC site. Photo taken Facing North towards Elm Street.

Photograph 4
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

View of treatment facility concrete footprint, utility lines and on-site wells (1 of 2). Photo taken Facing West across SSC site towards Main Street.

Photograph 5
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

Close-up view of treatment facility concrete footprint, utility lines and on-site vault and wells (2 of 2). Photo taken Facing West on-site towards Main Street.

Photograph 6
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

Close-up view of treatment facility concrete footprint and on-site out building (1 of 2). Photo taken facing South across SSC site.

Photograph 7
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

Close-up view of treatment facility concrete footprint and on-site wells (2 of 2). Photo taken facing Southwest across SSC site.

Photograph 8
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

View of CW-1 well within fence due to incomplete closure of well. Photo taken facing North.

Photograph 9
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

Close-up photo of outcrop over Roberts Spring. Photo taken facing North.

Photograph 10
Solid State Circuits Site
Republic, MO
Photo Taken 03/06/2012
Candice McGhee,
DEQ/HWP/SPF

Close-up photo of Roberts Spring. Photo taken facing Northeast.

DAY OF FIRE SITE PHOTOGRAPHS

Photograph 1
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Candice McGhee, DEQ, HWP, SF
Photo of east side of air stripper (treatment) building.

Photograph 2
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Candice McGhee, DEQ, HWP, SF
Photo of north side of air stripper (treatment) building. Photo taken Facing West towards Main Street.

Photograph 3
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Candice McGhee, DEQ, HWP, SF
Photo of north side of air stripper (treatment) building

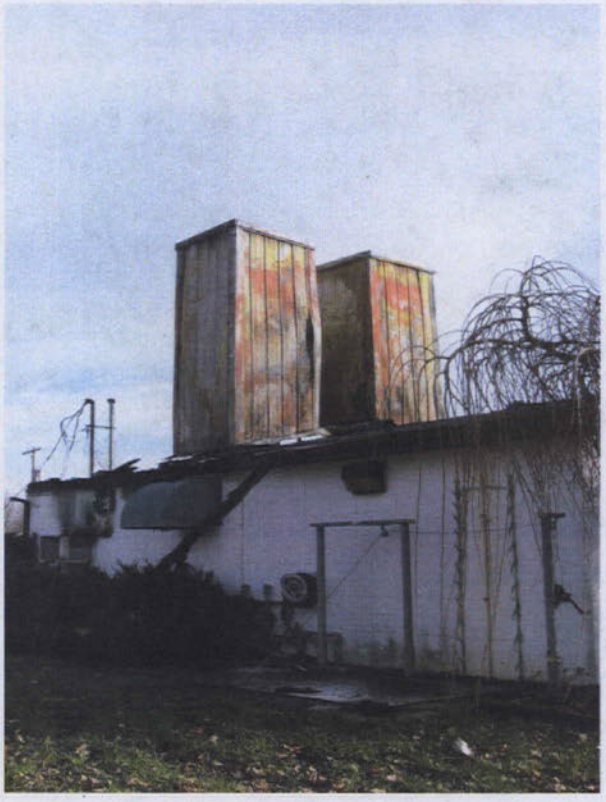
Photograph 4
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Candice McGhee, DEQ, HWP, SF
Photo of north side of air stripper (treatment) building

Photograph 5
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Wendell Hall DEQ, SWRO
Photo south side of air stripper (treatment) building.

Photograph 6
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Wendell Hall DEQ, SWRO
Photo west of air stripper (treatment) building.

Photograph 7
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Candice McGhee DEQ, HWP, SF
Photo of Equalization Tank.

Photograph 8
Solid State Circuits Site, Republic, MO
Date: 12/08/2011, Candice McGhee DEQ, HWP, SF
Photo of first air stripper & transfer motor (behind legs) and computer shell (foreground).



Photograph 9
Solid State Circuits Site,
Republic, MO
Date: 12/08/2011
Candice McGhee
DEQ, HWP, SF
Photo of north side of air stripper bldg.

Photograph 10
Solid State Circuits Site
Republic, MO
Date: 12/08/2011
Candice McGhee
DEQ, HWP, SF

Photo of Equalization Tank and debris.

Photograph 11
Solid State Circuits Site
Republic, MO
Date: 12/08/2011
Candice McGhee, DEQ,
HWP, SF

Photo of first air stripper and debris. Door to Equalization Tank Room.

Photograph 12
Solid State Circuits Site,
Republic, MO
Date: 12/08/2011
Candice McGhee
DEQ, HWP, SF
Photo of second air stripper & transfer motor (background) and computer shell (foreground).

Photograph 13
Solid State Circuits Site
Republic, MO
Date: 12/08/2011
Candice McGhee
DEQ, HWP, SF

Photo of debris along east wall in air stripper room.

Photograph 14
Solid State Circuits Site
Republic, MO
Date: 12/08/2011
Candice McGhee
DEQ, HWP, SF

Photo of fire damaged air stripper stacks.

Photograph 15
Solid State Circuits Site, Republic, MO
Date 12/08/2011, Wendell Hall, DEQ, SWRO
Photo of SSC site, south of site and along Main Street.

Photograph 16
Solid State Circuits Site, Republic, MO
Date 12/08/2011, Wendell Hall, DEQ, SWRO
Close-Up photo of entrance to Equalization Tank Room

Photograph 17
Solid State Circuits Site, Republic, MO
Date 12/08/2011, Wendell Hall, DEQ, SWRO
Photo of entrance to Air Stripper Room along east side of building.

Photograph 18
Solid State Circuits Site, Republic, MO
Date 12/08/2011, Wendell Hall, DEQ, SWRO
Photo along south side of Air Stripper building with entrance to Equalization Room and debris

Attachment E

SITE INSPECTION CHECKLIST AND ROSTER

Site Inspection Checklist

I. SITE INFORMATION	
Site name: Solid State Circuits	**Date of inspection:** 03/06/2012
Location and Region: Republic, MO	**EPA ID:** MOD980854111
Agency, office, or company leading the five-year review: Missouri MDNR/HWP	**Weather/temperature:** Sunny, Warm (70°),Windy

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Monitored natural attenuation
- ☒ Access controls
- ☐ Groundwater containment
- ☒ Institutional controls
- ☐ Vertical barrier walls
- ☒ Groundwater pump and treatment (until 12/08/2011 fire)
- ☐ Surface water collection and treatment
- ☒ Other: On December 8, 2011, an on-site fire totally destroyed the treatment facility including the pump & treat equipment and the building housing the equipment.

Attachments: ☒ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Jason Smith & Meredith Kenworthy EWI 03/06/2012
   Name Title Date
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

2. **O&M staff** Jason Smith & Meredith Kenworthy EWI 03/06/2012
   Name Title Date
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☒ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency Republic's Planning & Economic Development
Contact Gail Noggle Director 03/06/2012 In-Person Interview
Name Title Date Phone no. 417-732-3115
Problems; suggestions; ☐ Report attached _____

Agency Republic's Public Works Department
Contact David Brock Director 03/06/2012 In-Person Interview
Name Title Date Phone no. 417-732-3400
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☒ O&M manual — ☒ Readily available — ☐ Up to date — ☐ N/A
   - ☒ As-built drawings — ☒ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Maintenance logs — ☒ Readily available — ☐ Up to date — ☐ N/A

   Remarks All on-site documents such as the O&M Plans, as-built drawings and maintenance logs were destroyed in the 12/08/2011 fire. As reported by EWI personnel, backup copies of all of the documents are now located at the EWI offices in Springfield, MO.

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☐ Up to date ☐ N/A
   - ☒ Contingency plan/emergency response plan — ☒ Readily available — ☐ Up to date — ☐ N/A

   Remarks All on-site documents such as the site-specific H&SP and Contingency/Emergency Response Plans were destroyed in the 12/08/2011 fire. As reported by EWI personnel, backup copies of all of the documents are now located at the EWI offices in Springfield, MO.

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A

   Remarks All on-site documents such as the O&M and OSHA Training Records were destroyed in the 12/08/2011 fire. As reported by EWI personnel, backup copies of all of the documents are now located at the EWI offices in Springfield, MO.

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☒ N/A
   - ☒ Effluent discharge — ☒ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Waste disposal, POTW — ☒ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Other permits _____ — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks All on-site documents such as the Effluent Discharge and Waste Disposal, POTW (NPDES / MSOP) were destroyed in the 12/08/2011 fire. As reported by EWI personnel, backup copies of all of the documents are now located at the EWI offices in Springfield, MO.

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A

   Remarks _____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A

   Remarks _____

7. **Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A

   Remarks All on-site documents such as the Groundwater Monitoring Records were destroyed in the 12/08/2011 fire. As reported by EWI personnel, backup copies of all of the documents are now located at the EWI offices in Springfield, MO.

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A

   Remarks

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Water (effluent) — ☒ Readily available — ☐ Up to date — ☐ N/A

   Remarks All on-site documents such as the Discharge Compliance (Effluent water) Records were destroyed in the 12/08/2011 fire. As reported by EWI personnel, backup copies of all of the documents are now located at the EWI offices in Springfield, MO.

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A

    Remarks Both the walk-in gate and the drive through gate are locked. The fence has barbed wire on top.

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☒ PRP in-house ☒ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other _____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date
☒ Funding mechanism/agreement in place (See Table XX in Section YY)
Original O&M cost estimate Annual O&M Costs was $445,300 from FS ☒ Breakdown attached

The actual total annual cost by year for FYR reporting period was:

From 10/01/2006 To 12/31/2006	$248,000	☐ Breakdown attached
Date Date	Total cost	
From 01/01/2007 To 12/31/2007	$664,000	☐ Breakdown attached
Date Date	Total cost	
From 01/01/2008 To 12/31/2008	$633,000	☐ Breakdown attached
Date Date	Total cost	
From 01/01/2009 To 12/31/2009	$790,000	☐ Breakdown attached
Date Date	Total cost	
From 01/01/2010 To 12/31/2010	$855,000	☐ Breakdown attached
Date Date	Total cost	
From 01/01/2011 To 12/31/2011	$660,000	☐ Breakdown attached
Date Date	Total cost	
From 01/01/2012 To _____	_____	☐ Breakdown attached
Date Date	Total cost	

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: The December 8, 2011 fire totally destroyed the treatment facility, which included the pump and treat equipment and the building housing the equipment. Since all of the equipment was destroyed, the groundwater from the extraction wells can't be pumped into the air strippers for VOC removal. Since there is currently no active treatment of the groundwater, the large volumes of treated water will not pass through Republic's sewer system to the Republic's POTW. This temporary cessation of the pump & treat operation has reduced the amount of O&M costs, since MRAC is temporarily not paying a sewer bill. Thus, the annual operational O&M costs for the SSC site are temporarily reduced until the remediation of the source soils in Areas 1, 2 and 3. (See "Question A, Costs of System Operations/Operation & Maintenance" for additional explanation.)

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☒ Location shown on Figure 4 ☒ Gates secured ☐ N/A

Remarks The fence damage from the December 8, 2011 fire had been repaired. Otherwise, no significant damage to fence was evident. The fence has barbed wire along the top including the gates. The walk-in and drive through gates are locked and secured at all times.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks There is posted a sign on drive through entrance gate and midway along all four fenced sides. See pre-fire photo.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Self-reporting
Frequency When necessary
Responsible party/agency EWI
Contact Jason Smith (Name) Site Project Manager (Title) _____ (Date) 417-890-9500 (Phone #)

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached
The write-up regarding ICs can be found in this FYR report.

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks The city of Republic instituted a City Ordnance within the city limits and the State established a "Sensitive Area C" designation within Greene County. The city of Republic Ordinance restricts the installation of new wells and the "Sensitive Area C" established the criteria for installing new wells.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks

2. **Land use changes on site** ☒ Yes ☐ No ☐ N/A

Remarks The land use potentially changed with the December 8, 2011 fire since the main on-site building that housed the treatment facility (pump &treat operation equipment) was destroyed and is no longer viable. The only structures currently located on-site are one permanent large out building used as storage and a temporary Baker tank used to temporarily store collected purge and sampling water.

3. **Land use changes off site** ☒ Yes ☐ No ☐ N/A

Remarks The day care (Kidzone) facility just north and across Elm Street has gone out-of-business. It appears to have closed sometime after the December 8, 2011 site fire.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A
   Remarks Upon entering the drive through gate, there exists a graveled driveway/parking area on the east side of the site that extends to the northern fence.

B. Other Site Conditions ☒ Applicable ☐ N/A

Remarks Since the December 8, 2011 fire, the debris within the pump & treat building was removed from the building segregated, characterized and properly disposed off-site. The destroyed pump & treat building was torn down and the debris was segregated, characterized and properly disposed off-site. Since the small permanent storage building was in poor shape, it too was torn down and the debris was segregated, characterized and properly disposed off-site. There is a medium-sized permanent storage building and a temporary Baker tank on-site. The Baker tank temporarily stores all collected purge and sampling water until it can be sampled and properly disposed.

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface ☐ Applicable ☒ N/A

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ▪ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks_____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☐ No obstructions
■ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks_____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**
☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
☐ Good condition ☐ Needs Maintenance
Remarks_____

2. **Gas Collection Wells, Manifolds and Piping**
☐ Good condition ☐ Needs Maintenance
Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
☐ Good condition ☐ Needs Maintenance ☐ N/A
Remarks_____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
Remarks_____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
Remarks_____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
☐ Siltation not evident
Remarks_____

2. **Erosion** Areal extent_____ Depth_____
☐ Erosion not evident
Remarks_____

3. **Outlet Works** ☐ Functioning ☐ N/A
Remarks_____

4. **Dam** ☐ Functioning ☐ N/A
Remarks_____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
Horizontal displacement_____ Vertical displacement_____
Rotational displacement_____
Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
Remarks_____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
Areal extent_____ Depth_____
Remarks_____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☐ Vegetation does not impede flow
Areal extent_____ Type_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. **Discharge Structure** ☐ Functioning ☐ N/A
Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent_____ Depth_____
Remarks_____

2. **Performance Monitoring** Type of monitoring_____
☐ Performance not monitored
Frequency_____ ☐ Evidence of breaching
Head differential_____
Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☒ Applicable ☐ N/A

1. Pumps, Wellhead Plumbing, and Electrical

☒ Good Condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A

Remarks Shortly after the December 8, 2011 fire, EWI inspected the pumps, wellhead plumbing and electrical lines at the wellhead of all potentially impacted wells. The February 27-March 2, 2012 sampling event, which was the initial sampling event post-fire, verified the operational status of the on-site and off-site extraction and monitoring wells.

2. Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances

☒ Good Condition ☐ Needs Maintenance

Remarks Previously attended split-sampling events demonstrated that the extraction system pipelines, valves, valve boxes and other necessary equipment were in good condition. The December 8, 2011 fire, totally destroyed all operational equipment within the main treatment building.

3. Spare Parts and Equipment

☒ Readily Available ☒ Good Condition ☐ Requires Upgrade ☐ Needs to be provided

Remarks Overall, EWI has maintained a good inventory of spare parts and equipment to keep the groundwater/surface water pump and treat system operational.

B. Surface Water Collection Structures, Pumps and Pipelines ☒ Applicable ☐ N/A

1. Collection Structures, Pumps and Electrical

☐ Good Condition ☐ Needs Maintenance ☒ N/A

Remarks _____

2. Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances

☒ Good Condition ☐ Needs Maintenance ☐ N/A

Remarks During the 2010 Supplemental Site Investigation, a troll (water & atmospheric measuring device) was placed in Robert's Spring. The device performed as expected.

3. Spare Parts and Equipment

☐ Readily Available ☐ Good Condition ☐ Requires Upgrade ☐ Needs to be provided ☒ N/A

Remarks _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
   ☒ Air stripping ☐ Carbon adsorbers
   ☐ Filters_____
   ☐ Additive (*e.g.*, chelation agent, flocculent)_____
   ☐ Others_____
   ☒ Good condition ☐ Needs Maintenance
   ☒ Sampling ports properly marked and functional
   ☒ Sampling/maintenance log displayed and up to date
   ☒ Equipment properly identified
   ☒ Quantity of groundwater treated since beginning of RI approximately 81 gallons
   ☐ Quantity of surface water treated annually_____
   Remarks All of the marked boxes above applied to the SSC site until the December 8, 2011 fire, which totally destroyed the on-site treatment facility (pump & treat system). The electric blower motor was found seized on the south air stripper unit. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire. The cause of the fire is being listed as accidental. Thus the treatment system is currently under Force Majeure/Excusable Delay conditions. See attached Fire Marshal's Report (Attachment B)

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☐ Good condition ☐ Needs Maintenance
   Remarks The electric blower motor was found seized on the south air stripper unit. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire. The cause of the fire is being listed as accidental. See attached Fire Marshal's Report (Attachment B).

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks The electric blower motor was found seized on the south air stripper unit. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire. The cause of the fire is being listed as accidental. See attached Fire Marshal's Report (Attachment B).

4. **Discharge Structure and Appurtenances**
   ☐ N/A ☐ Good condition ☐ Needs Maintenance
   Remarks The electric blower motor was found seized on the south air stripper unit. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire. The cause of the fire is being listed as accidental. See attached Fire Marshal's Report (Attachment B).

5. **Treatment Building(s)**
   ☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
   ☐ Chemicals and equipment properly stored
   Remarks The electric blower motor was found seized on the south air stripper unit. It could not be eliminated that an electrical malfunction or other malfunction with this motor had caused this fire. The cause of the fire is being listed as accidental. See attached Fire Marshal's Report (Attachment B).

6. **Monitoring Wells** (pump and treatment remedy)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☒ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks As part of the Force Majeure/Excusable Delay conditions all of the site's monitoring wells were located and verified as functional during the February 27-March 3, 2012 sampling event. The sampling event served as the baseline sampling event for the Force Majeure/Excusable Delay conditions, the spring sampling event and the upcoming Pilot Project.

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

Remarks Overall, the monitoring data EWI has supplied the last five years has been of acceptable quality; however, some comments injected within the documents have not been of acceptable quality.

2. **Monitoring data suggests:**

☐ **Groundwater plume is effectively contained** ☐ **Contaminant concentrations are declining**

Remarks The EPA changed the status of the "Groundwater Under Control Environmental Indicator" for the SSC site to "Not Under Control" effective January 27, 2012, due to the December 8, 2011fire that destroyed the pump and treat system.

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☒ N/A

Remarks _____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

The "Pilot Project Work Plan for Area1" was approved by the Agencies on June 13, 2012. MRAC/EWI will implement a pilot project ISCO treatment of the soil source area (Area 1) in 2012. Shortly thereafter a Work Plan will be submitted for the ISCO treatment of the soil source areas (Area 2/3).

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The SSC remedy was a groundwater containment, removal and restoration remedy. Until the December 8, 2011 on-site fire, monitoring and sampling had determined that the remedy was achieving VOC contaminant containment, was achieving limited removal success and was slowly restoring the three groundwater aquifers. The destruction of the on-site treatment facility (pump & treat operation) by the December 8, 2011 fire has changed the operational component of the remedy and thus may be impacting the SSC site. Due to the current operational uncertainties, the EPA changed the status of the "Groundwater Under Control Environmental Indicator" for the SSC site to "Not Under Control" effective January 27, 2012. See Executive Summary regarding the effectiveness of the remedy.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The EPA changed the status of the "Groundwater Under Control Environmental Indicator" for the SSC site to "Not Under Control" effective January 27, 2012, due to the December 8, 2011fire that destroyed the on-site treatment facility (pump and treat system). See Section IV. C of the FYR report related to O&M procedures.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

The original SSC remedy as found in the 1989 ROD stated: "The selected remedy addresses only the contamination of the groundwater aquifers. Previous response actions removed the soil as the source of continuing contamination." It was determined during this FYR period that this assumption was incorrect and additional soil will need to be removed or fully remediated in order for the chosen groundwater remedy to have a chance of being effective and/or function as designed.

The destruction of the on-site treatment facility (pump & treat operation) by the December 8, 2011 fire has changed the operational component of the chosen remedy and thus may be impacting the SSC site. Due to the current operational uncertainties, the EPA changed the status of the "Groundwater Under Control Environmental Indicator" for the SSC site to "Not Under Control" effective January 27, 2012, See Section IV. C of the FYR report related to O&M procedures.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

The "Pilot Project Work Plan for Area1" was approved by the Agencies on June 13, 2012. MRAC/EWI will implement a pilot project ISCO treatment of the soil source area (Area 1) in 2012. This work was originally proposed as an opportunity for optimization; however, it is also now being handled as part of a Force Majeure/Excusable Delay situation due to the destruction of the on-site treatment facility (groundwater pump & treat remedy) by the December 8, 2011 fire.

Site Inspection Team Roster		
Personnel	**Representing**	**Phone Number**
Candice McGhee	MDNR/HWP	573-751-1738
Dan Gravatt	EPA Region VII	913-551-7324
Jason Smith	EWI	417-890-9500
Meredith Kenworthy	EWI	417-890-9500
Gail Noggle, Director	Republic's Planning & Economic Development	417-732-3115
David Brock, Director	Republic's Public Works Department	417-732-3400

Attachment F

PUBLIC NOTICE

Missouri Department of Natural Resources
to conduct
Fourth Five-Year Review for the
Solid State Circuits Superfund Site
Republic Missouri

The Missouri Department of Natural Resources will conduct the Fourth Five-Year Review at the Solid States Circuit Superfund site. The review is required by the Superfund law to make sure the cleanup continues to protect human health and the environment.

The **Administrative Record** is available during normal business hours:

Springfield/Green County Library
Republic Branch Library
921 N. Lindsey
Republic, MO 65738
417-732-7284

Questions or requests for information can be submitted to:

Candice McGhee
Project Manager
573-751-1738

Attachment G

INFORMATION SHEET

The Missouri Department of Natural Resources

Information Sheet

September 2011

Fourth Five-Year Review to Begin
Solid State Circuits Superfund Site
Republic, Missouri

Introduction

The Missouri Department of Natural Resources, on behalf of the U.S. Environmental Protection Agency (EPA), conducts regular five-year reviews on Superfund sites where cleanups are ongoing; yet have not been completed. These reviews are required by the Superfund law [42 U.S.C. Section 9621 (c)]. The Department has initiated its fourth five-year review of the Solid State Circuits Superfund Site in Republic, MO.

Site Background

The Solid State Circuits Superfund site covers one-half acre in downtown Republic. Trichloroethylene (TCE) was detected in the city of Republic's *Municipal Well No. 1* (CW-1) in the 1980s. The CW-1 well provided a large portion of the drinking water for Republic. An investigation by the Department determined that Solid State Circuits, a former printed circuit board manufacturer, was the source of the TCE contamination. Contamination was also found in on-site and off-site groundwater, on-site soils, and in the remaining basement structure of a former building on the site.

The site removal actions completed between 1983 and 1985, after the facility building was destroyed by fire, included:

- removal of 2,000 cubic yards of contaminated material,
- plugging and sealing of the basement's well,
- removal of Republic's CW-1 well from service,
- the basement was filled in with rock topped with 2 foot of soil that was graded and seeded, and
- installation of a fence with a locking gate for added for security.

The site remedial actions completed between 1989 and 1994 consisted of:

- the installation of CW-4 and CW-5 wells,
- installation of additional on-site and off-site monitoring wells to monitor the cleanup of the contaminated groundwater,
- installation of groundwater extraction wells, and
- creation of an on-site treatment facility to treat the extracted contaminated groundwater.

Five-Year Review

The Department will study recent site information during this fourth five-year review and inspect the site to determine if the remedy continues to be protective of human health and the environment. The Department encourages members of the community to ask questions and report any concerns about the site. A final report will be prepared at the end of the review and will be available at the site information repository

Additional Information
The site administrative record is available during normal library hours:

Springfield/Green County Library
Republic Branch Library
921 N. Lindsey
Republic, MO 65738
417-732-7284

Questions or requests for information can be submitted to:

Candice McGhee
Project Manager
Department of Natural Resources
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